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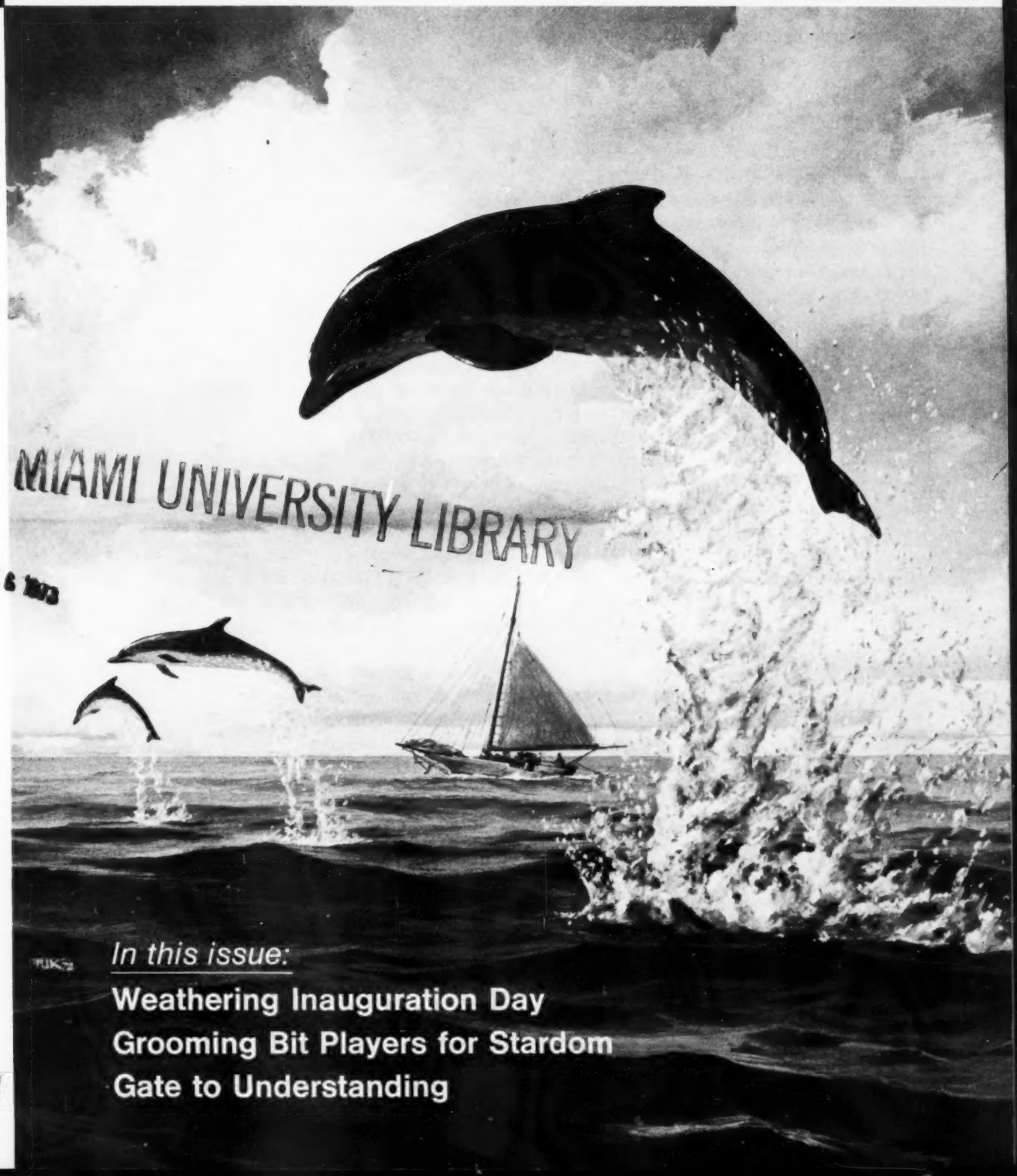
NOAA

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



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Grooming Bit Players for Stardom
Gate to Understanding

VOLUME 3
NUMBER 1

NOAA

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Peter G. Peterson, Secretary

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JANUARY 1973
VOLUME 3 NUMBER 1

STANLEY B. EAMES
Director, Public Affairs

ANN K. COOK
Associate Editor

MAX M. CHESY
Art Director

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A Message From the Administrator

ROBERT M. WHITE

On October 27, 1972, President Nixon signed the Coastal Zone Management Act of 1972, one of the most significant environmental management measures to come out of Congress during the year. The Act vests in the Secretary of Commerce the management of Federal responsibilities in the Nation's coastal zone, and administration of the Act has been delegated to NOAA.

The Act establishes a national policy of preserving, protecting, developing, and where possible restoring and enhancing the resources of the coasts. Primary responsibility for coastal zone management remains with the States, where it properly belongs, and the Federal role is to encourage and assist the States to exercise this responsibility effectively. A two-stage Federal grants program will be used to assist states in developing management programs and—following approval of the States' individual plans—to aid them in administering their plans. The legislation does not force any State to participate.

Recognition of the need for protecting the Nation's estuaries and coastal zone from misuse has become widespread only in the past decade. The coastal zone—defined as the coastal waters (including bottom lands) and adjacent shorelands strongly influenced by each other, seaward to the outer limit of the territorial sea—is important economically, esthetically, and ecologically. Shipping routes crisscross the waterways and harbors dot the coast. Commercial and sports fishermen hunt finfish and shellfish, while an increasing number of aquaculture projects seek to grow and harvest these living resources. Oil companies pump millions of barrels of raw petroleum from offshore deposits, and mining firms dredge vast quantities of sand and gravel from the bottom. Industry, power plants, land developers, and marina operators vie for a place on the shores, and citizens on a holiday seek beaches for swimming, sunning, or surfing.

Reconciling these many demands while preserving the coasts for future use requires careful State planning. The NOAA Office of Coastal Zone Management will provide incentive and encouragement to them to manage their coasts and resources in a rational fashion. Since the signing of the Act we have been engaged in planning and consultation with officials of the affected States and territories—all those bordering the oceans and the Great Lakes—and will draw upon the scientific and technical resources of NOAA organizations to the maximum extent. Information and guidance from the Sea Grant universities, private research organizations, and state resources are also being sought.

With its broad technical competence and expertise in coastal zone operations such as charting, research, advisory services, and environmental monitoring, as well as its close ties with State agencies, NOAA can approach its tasks assigned by the Act with confidence. With the cooperation of all, we will succeed in this great responsibility.

Robert M White

Although climatic odds favor fair weather, the elements have a history of misbehaving for the inauguration of the President.

WEATHERING INAUGURATION DAY

BY PATRICK HUGHES

"The worst weather on the face of the earth," said one eyewitness Congressman of the snowstorm that nearly buried the inauguration of William Howard Taft in 1909.

Heavy snow began the day before and continued through the night, driven by a stinging, whistling wind. Branches and telegraph and telephone lines snapped under the weight of the wet, clinging snow, while the wind toppled trees and poles. Pedestrians were quickly driven indoors and carriages and streetcars were immobilized as a thick white mantle submerged the deserted streets of the Nation's Capital.

Six thousand shovelers struggled vainly through the night and forenoon to clear the areas in front of the White House and Capitol, and the route between. As noon approached, the storm still howled on unabated. People stood huddled in doorways or peered out at the arctic landscape through snow-streaked windows. Postponing his decision until the last moment, Taft finally decided to take his oath of office in the Senate Chamber, rather than on the outdoor platform erected in front of the Capitol. Ironically, the snow stopped just a few minutes later and despite the icy, piercing wind, people began lining Pennsylvania Avenue for the inaugural parade.

Some 20,000 marchers sloshed past the snow-covered stands flanking the parade route. The wind howled through their ranks, playing particular havoc with the high-hatted representatives of various political clubs, while decorations and bunting whipped about in wind-torn shreds or sagged sadly under heavy burdens of snow. All in all, it was the worst Inauguration Day weather in the nation's history. Quipped President Taft to a reporter friend: "I always knew it would be a cold day when I got to be President."

Mr. Taft was presumptuous, however, in thinking that the elements had singled him out personally; they have been just as attentive to many other presidents.

It was a much colder day, for example, on Ulysses S. Grant's second inauguration in 1873; it was, in fact, the coldest Inauguration Day on record. When cannon-fire announced the dawn, the

Smithsonian Photograph.

The rainy inaugural parade of President Benjamin Harrison in 1889.

temperature was four degrees above zero; by noon it had risen only to 16 degrees. Throughout the day, gusty winds up to 40 miles per hour buffeted Washington—bitterly cold blasts that knifed through the heaviest clothing and chilled to the marrow all who ventured outdoors.

Despite the cold and wind, however, large crowds filled the streets. Heavy clothing and earmuffs were the uniform of the day, except for the West Point cadets and Annapolis midshipmen who were scheduled to parade without overcoats. When President Grant delivered his inaugural address, the wind made his words unintelligible to all but those next to him. Meanwhile, a number of the lightly dressed cadets and midshipmen, who had to stand on the windswept Mall for more than an hour and a half, lost consciousness and collapsed; several were reported "frozen."

It was almost as cold at the inaugural ball that night, held in a $40,000 temporary building erected on Judiciary Square. The contractor had neglected to install heating equipment. It was so cold that the guests danced in their overcoats and heavy wraps, and when the President left just after midnight, so did everyone else.

Franklin Delano Roosevelt's second inauguration in 1937 was the wettest in history. It was a cold, miserable day. The temperature hovered just above freezing, while wind-blown rain fell in soaking, slanting sheets. Thousands of soggy spectators stood for hours in the downpour under a canopy of largely ineffective umbrellas. As he rode from the White House to the Capitol for the swearing-in ceremonies, Roosevelt repeatedly leaned out the window of his limousine to wave to umbrellaed knots of people clustered like black mushrooms along Pennsylvania Avenue.

Undaunted by the cold, driving rain, thousands more had massed in front of the Capitol to witness the inaugural oath. Under the umbrellas, overcoats and raincoats predominated, but despite the deluge, some spectators wore formal attire. On the inaugural platform itself, attendants dumped puddles of water from chairs as Cabinet members and Supreme Court justices waded down a water-logged red carpet to their wet seats. Icy torrents blowing in under the roof bathed Congressmen, government officials, and guests alike, as Mrs. Roosevelt raced back and forth, carrying blankets for family and friends.

The head of the Inaugural Committee tried to persuade Roosevelt to take his oath indoors, but Roosevelt replied: "If they can take it, I can take it," and led Vice President-elect John Nance Garner out to the inaugural stand. The shivering, soggy crowd burst into cheers as Roosevelt was sworn in at 12:39 p.m., his right hand resting on the cellophane-wrapped old Dutch Bible of Claes Martenzen van Roosevelt. All during his inaugural address, the rain beat steadily on the President's face, and several times he had to pause to wipe the water off.

Roosevelt insisted on an open car for the return ride to the White House. The thoroughly soaked President and First Lady—her new hat a drooping disaster—rode the mile to the Executive Mansion laughing and waving to the crowds, which often responded in kind. Later, Roosevelt spent another hour and a half reviewing the inaugural parade from a specially constructed reviewing stand, an $11,000 model of Andrew Jackson's home, the Hermitage; he even had the bullet-proof windows removed, the better to be seen and rained on.

Roosevelt's saturated inauguration was particularly ironic: The 20th Amendment had just changed the date of Inauguration Day from March 4 to January 20, and the new date supposedly favored drier, though colder weather. Said Senator George William Norris of Nebraska, author of the 20th Amendment, "They're trying to blame this on me. You can't charge this up to me until after March 4, when you see what kind of day that is." It was a beautiful day—sunny, with a high temperature of 67 degrees, unusually warm for that date.

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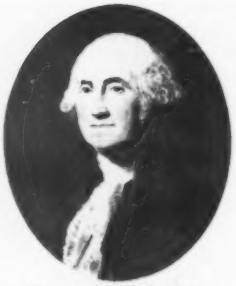
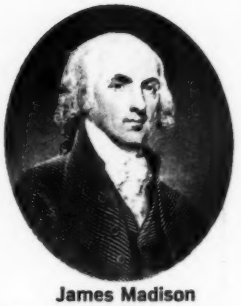


George Washington
April 30, 1789, New York City, cool and clear
1793, Philadelphia, pleasant

John Adams
1797, Philadelphia, fair

Thomas Jefferson
1801, mild and beautiful
1805, fair



James Madison
1809, probably fair
1813, probably fair

James Monroe
1817, warm and sunny
March 5, 1821, 28°, snow

John Quincy Adams
1825, 47°, rain

Andrew Jackson
1829, warm and balmy
1833, probably fair

Martin Van Buren
1837, sunny and brisk

Temperatures given are for noon. Except where noted, inaugurations were in Washington, D.C. Prior to 1937, the Presidential oath of office was taken on March 4; after 1973, on January 20, unless Inauguration Day fell on a Sunday.

Bad weather on Inauguration Day is a celebrated tradition of American political folklore only too well documented in fact. Indeed, as in Mr. Roosevelt's case, it often seems as if a perverse intelligence was orchestrating the event's environmental accompaniment. This impression is reinforced when you consider that the weather was beautiful for the first seven inaugurations—all held indoors (although George Washington took his first oath of office on the balcony of Federal Hall in New York City)—but turned sour soon after the ceremonies were moved outdoors. Of the 39 regularly scheduled Inauguration Days that followed, 19 were plagued by rain, snow, sleet, or bitter cold.

Tradition has it that the First Congress chose March 4 as Inauguration Day out of respect for the Sabbath, because it is the date that quadrennially falls least frequently on Sunday. Official weather records date back only to 1871, shortly after the first national weather service was established by the Army's signal Service. Other source materials however—in the form of private weather diaries and fragmentary institutional records preserved in the archives of the Environmental Data Service's National Climatic Center in Asheville, N.C., National Archives, and various historical societies, as well as contemporary newspaper accounts—make it possible to trace the thread of bad weather woven through the pageantry of Inauguration Day back to its origin.

All but the first three inaugurations took place in Washington. The first was held in New York City in 1789, the second and third in Philadelphia, in 1793 and 1797, respectively, before the Nation's Capital was moved to the new Federal City in 1800. The first outdoor inauguration was James Monroe's, held in Washington on March 4, 1817. Almost as if to lull participants into a false sense of security, the weather was warm and sunny, with not a cloud in the sky.

Bad weather struck the very next inauguration, Monroe's second in 1821. For the first time, Inauguration Day fell on a Sunday and the ceremonies were postponed until the next day. According to the Daily National Intelligencer, a "good deal" of rain and snow fell during the night. John Quincy Adams, a student of weather, as were George Washington, Benjamin Franklin, and Thomas Jefferson before him, recorded rain for Sunday and snow for Monday, but indicated no times nor amounts. Whatever the elemental sequence of events, Monroe took his oath of office indoors, in the House Chamber, where an "immense crowd" of cold, damp men and women thronged the Gallery to witness the swearing-in.

John Quincy Adams also took weather observations on his own Inauguration Day, four years later, when it rained. Once again, the ceremonies were held indoors.

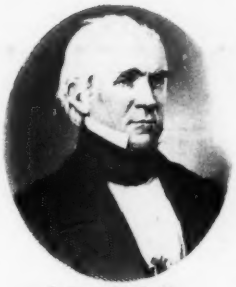
In 1845, James Knox Polk took his oath of office outdoors in the pouring rain. The Capitol Mall was roofed by a host of glistening umbrellas under which spectators stood densely packed, up to their ankles in mud and water. The roar of the rain on their umbrellas drowned out Polk's words as he delivered his inaugural address.

The parade back to the White House was a shambles. Floats had been reduced to soppy paper-and-cloth monstrosities and, as Polk's carriage moved up Pennsylvania Avenue in the downpour, the President saw mostly the backs of spectators splashing to shelter.

It also rained on the morning of Abraham Lincoln's first inauguration in 1861, but the rain stopped by midmorning and the sun came out in the afternoon. The elements were not quite as considerate for his second inaugural in 1865.

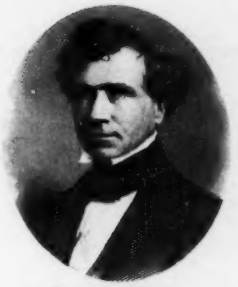
It had been raining for two days, and the Capital City was a

William Henry Harrison
1841, overcast, chilling wind



James K. Polk
1845, rain

Zachary Taylor
March 5, 1849, 42°, cloudy, intermittent snow flurries



Franklin Pierce
1853, snow throughout the day

James Buchanan
1857, 49°, bright and sunny

Abraham Lincoln
1861, rain till mid-morning, sunny and warm in afternoon
1865, 45°, rain

Ulysses S. Grant
1869, 40°, .106" rain, sunny afternoon
1873, 16°, clear, windy, and bitterly cold

Rutherford B. Hayes
March 5, 1877, 35°, cloudy, brief periods of light snow

sea of mud. According to the New York Herald, the streets were "flooded and afloat with a vile yellow fluid not thick enough to walk on nor thin enough to swim in." Many people who had been unable to find rooms in the crowded city slept in the Capitol. No one had the heart to put them out in the rain, even when the time came to clear the building for the inaugural ceremonies.

Despite the downpour, a good-sized crowd of drenched men, women, and children waited patiently in front of the Capitol and cheered when Lincoln came out, just moments after the rain finally ended. Dark clouds were still scudding across the sky as Lincoln began his inaugural address, but soon sunlight broke through and lit the face of the Capitol behind him.

James Garfield's Inauguration Day took place on March 4, 1881. It snowed all the night before, and by midnight deep drifts were everywhere. The next morning, streets were impassable, except for Pennsylvania Avenue between the Capitol and White House, where workmen had spent the night shoveling the snow from the street onto the sidewalk as fast as it fell. The snow finally ended about midmorning. Most of the decorations were ruined, and snow-covered bleacher seats originally priced at five dollars now sold for fifty cents. There were few takers. As Garfield delivered his inaugural address, a chill wind whistled through still-naked tree limbs and the temperature hovered just one degree above freezing.

It snowed again on Grover Cleveland's second inauguration in 1893. Rain began the evening of March 4, then changed to snow during the night. The next morning the city was being battered by a chill wind, and temperatures were well below freezing. Pennsylvania Avenue was almost deserted, and Cleveland's mustache reportedly glistened with tiny icicles as the President-elect rode to the Capitol for the ceremonies.

Some ten thousand shivering people were huddled around the inaugural platform when he arrived; according to a contemporary account, many kept warm with "jokes and flasks." The snow stopped about one o'clock, but the wind whipped in icy blasts that cracked the robes of the Supreme Court justices like rifle reports. Cleveland clutched his high hat tightly in his left hand and began his inaugural address. The wind caught his words and carried them to the crowd. High winds continued throughout the day, and a fireworks display scheduled for the evening had to be cancelled.

Bad weather also cancelled the fireworks display planned for William McKinley's second inauguration in 1901. Rain began during the swearing-in and continued through most of the afternoon. The crowd that witnessed the inaugural oath were described as the smallest in many years; only a handful of people sat scattered among the 7,000 seats facing the temporary platform erected on the East Portico of the Capitol.

In 1929, Herbert Hoover was sworn in, delivered his inaugural address, then marched in intermittent rain that began just before he took his oath of office and continued throughout the day. The weather did little to dampen the spirits of the crowds which jammed Pennsylvania Avenue, making it impossible for anyone to run for cover during the downpours. Most of the spectators endured the drenching good-naturedly; many, with water running down their faces and coat collars, laughed at the soaking.

Just before the swearing-in, it began to rain very hard, but with an estimated 100,000 people thronging the Capitol grounds and nearby streets, Hoover went ahead with the outdoor ceremonies. The President-elect took his oath of office with water beading his face. By the time he returned to the White House, Hoover was thoroughly soaked; at 3 p.m., however, he took his place in the stand in front of the White House and watched 20,000 military and civilian marchers pass in review, in the pouring rain.

The second worst snowstorm in the history of the event greeted the Inauguration Day of John F. Kennedy in 1961. Only President

continued

James A. Garfield
1881, 33°, snow until about 10 a.m., sunny, windy afternoon

Grover Cleveland
1885, 54°, bright, sunny day
1893, 25°, snow and chilling winds

Benjamin Harrison
1889, 43°, rain all day, .86 inch

William McKinley
1897, 40°, clear
1901, 47°, overcast, rain began during ceremony

Theodore Roosevelt
1905, 45°, sunny, patches of snow on the ground, strong wind

William Howard Taft
1909, 32°, heavy snow, strong winds

Woodrow Wilson
1913. 55°, overcast
March 5, 1917, 38°, partly cloudy, windy

Warren G. Harding
1921, 38°, clear, sunny

Taft before him had worse weather, but in 1909 Washington, D.C. did not have the massive traffic tie-up that paralyzed the Capital City on the eve of Kennedy's inauguration.

Heavy snow began falling the afternoon before and by evening most streets and roads were impassable. Thousands of motorists were stranded in the storm. Police switchboards were soon swamped with calls from people trying to find wives, husbands, and children who had not come home. Many of the missing were still sitting in their stalled cars trying to keep warm, and would remain there for hours before help reached them. Others simply abandoned their autos wherever they stalled, and set off on foot through the blinding storm.

Some 12,000 people had paid $100 a ticket to attend an inauguration-eve show-business gala, but only half of them were able to make it. President-elect Kennedy himself missed several appointments while battling the elements, and former President Herbert Hoover missed the inauguration altogether, because the storm prevented his plane from landing.

The snow ended by dawn, but it was bitterly cold, and a biting wind was to blow all day. Snowplows and sanders had worked throughout the night, and the inaugural parade route was in reasonably good shape. At noon, the temperature was a chill 22 degrees as some 20,000 shivering spectators sat huddled between snowbanks at the Capitol Plaza to witness the swearing-in. Later, despite the cutting, icy blasts, an estimated one million people watched the inaugural parade, which included 30,000 marchers, a PT boat, and the eight surviving members of the crew Kennedy had commanded in World War II. As twilight came, the cold deepened and people began drifting away. By the time the last marcher had passed, the President, his brother Robert, and Robert's wife, Ethel, were almost alone on the reviewing stand.

On the last Inauguration Day, in 1969, Richard M. Nixon took office on a raw, threatening, day, his hand resting on two family Bibles held by his wife. The temperature was 35 degrees and a chill northeast wind was blowing. The sky was overcast and lowering, though a pale sun occasionally shone dimly through thickening clouds during the ceremonies. It was cold in the stands, and many people applauded the oath and inaugural address by stamping on the floorboards, rather than by clapping their hands.

Despite the sullen weather, a great crowd lined Pennsylvania Avenue for the inaugural parade. Some 38,000 bleacher-seat holders had come early in the morning, equipped with warm clothing and raingear, stoically determined to sit out the weather, whatever came.

The parade got started about 2:30 p.m., and it was almost 5:30 when the last of the color guard, floats, and high-stepping bands passed the Presidential reviewing stand in the dark. It began to rain and sleet very lightly about an hour before the parade ended, but the President stayed until it was over, then left the reviewing stand to shake hands with the remaining spectators.

Someone said he was pretty brave to have stayed outdoors for so long in the damp, chill weather, to which Mr. Nixon replied: "But I had coffee. I'm not as brave as you."

Despite the event's rather dismal track record, the climatic odds favor fair weather for Mr. Nixon's second Inauguration Day. The normal high temperature for January 20 is 44 degrees, the low, 29 degrees. The highest temperature recorded in the last 100 years is 71 degrees, in 1951; the lowest, 8 degrees, in 1940. If it does rain or snow on Inauguration Day, the odds are it will just wet the pavement.

Average weather conditions for noon, when the President-elect is usually sworn in, would be a temperature of about 37 degrees, a wind of 10 miles an hour or less, and partly cloudy skies. Chances of precipitation during the swearing-in ceremony itself are only about one in six, and of snow, about one in twenty.

Calvin Coolidge
1925, 44°, mostly sunny

Herbert C. Hoover
1929, 48°, .40" rain

Franklin D. Roosevelt
1933, 42°, cloudy
1937, 33°, 1.77" rain
1941, 29°, clear with brisk wind
1945, 35°, cloudy, light snow on the ground

Harry S. Truman
1949, 38°, mostly sunny, windy

Dwight D. Eisenhower
1953, 49°, cloudy
January 21, 1957, 44°, cloudy, light snow

John F. Kennedy
1961, 22°, snow in early morning; sunny, chilling wind

Lyndon B. Johnson
1965, 38°, cloudy, snow on the ground

Richard Nixon
1969, 35°, overcast, chill northeast wind

Of course, it will rain or snow on some January 20th's, and January temperatures often make standing outdoors for several hours a chilling experience.

For the most part, the weather woes that have afflicted Presidential inaugural ceremonies have meant inconvenience, discomfort, and perhaps a cold to the participants. There have been exceptions, however. The first American President to die in office was a victim of Inauguration Day weather, and of his own disregard for its consequences.

At 68, William Henry Harrison was the oldest man ever to become President, and the last President born (1773) before the American Revolution. His Inauguration Day in 1841 was overcast, windy, and cold; so cold and chilling, in fact, that building owners along Pennsylvania Avenue were reported to have charged $500 for window space to watch the parade (for one dollar you could step up and take a quick look).

Harrison himself, ever the tough old soldier, showed nothing but contempt for the elements. He refused the offer of a carriage and, without overcoat or hat, rode a white charger in the two-hour procession from the White House to the Capitol. After being sworn in as the ninth President of the United States by Chief Justice Taney, he returned to the White House on horseback in another slow-moving parade, then for three hours shook hands with thousands of well-wishers. That night, after attending three inaugural balls, again lightly dressed, he returned exhausted to the Executive Mansion, where he suffered a "chill." In the weeks that followed the weather continued raw and bitter, and Harrison persisted in ignoring it, wearing neither hat nor coat, while the chill became a lingering cold. One morning he went out in a downpour and got soaked to the skin, then returned to the drafty White House, where he worked all day in his wet clothes. His cold deepened into pneumonia, and Harrison slipped into a coma. He died on April 4, 1841, a victim of his militant disdain for the elements.

Inauguraton Day weather alone was responsible for the death of President Fillmore's wife in 1853. Heavy snow was falling when citizens of the Capital City awoke on March 4, but it stopped shortly before noon. Franklin Pierce, the President-elect, had just finished his oath of office and was beginning his inaugural speech when the snow began again, cancelling plans for a parade back to the White House. Pierce dropped ex-President Fillmore and his wife off at the Willard Hotel, then continued on to the Executive Mansion to greet the crowd that had gathered there. Meanwhile, Abigail Fillmore had developed a bad cold from her exposure during the swearing-in ceremonies, a cold which soon developed into pneumonia. She died at the end of the month.

In 1889, Benjamin Harrison, despite his grandfather's tragic example 48 years earlier, insisted on taking his oath of office in the pouring rain. It had been raining for several days, and the evening before. Harrison had also insisted on taking his usual long daily walk, rain or no rain.

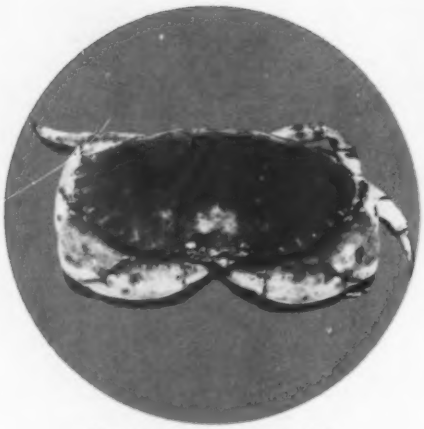
There were fewer than 200 people on the inaugural platform when the dripping Presidential procession arrived at the East Portico of the Capitol for the ceremonies, but some 20,000 spectators stood on the Capitol Plaza, their shiny, black umbrellas buffeted by wind and rain. The elements drowned out Harrison's oath of office. Despite his inaudibility, the President-elect stood in the downpour and delivered a long, rambling inaugural address—a very long one. When he finished, only a few thousand spectators remained; even his wife and daughter had gone indoors.

Undaunted, Harrison went to the White House reviewing stand to watch the inaugural parade. By dark, the surrounding stands were deserted, except for a few solitary figures huddled under umbrellas. Harrison still stood there ignoring the pouring rain, almost as if settling a personal account with the elements. □

As resources become depleted, and demand for seafood grows, the National Marine Fisheries Service is

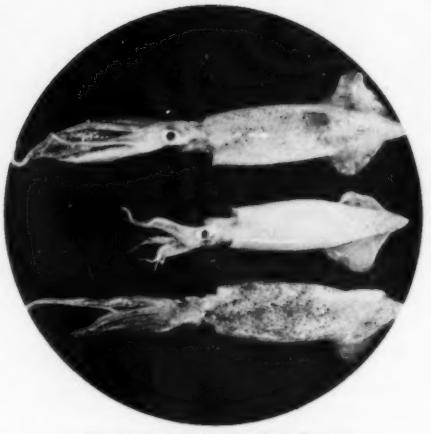
GROOMING BIT PLAYERS FOR STARDOM

BY RICK GUIDICE* and ANN WEEKS



The Jonah crab is caught in deep waters off New England.

Because it eats small shellfish, the croaker has a light shellfish flavor.



Squid is a delicacy little known to United States consumers.

Broiled lobster, filet of sole, fried shrimp, and tuna salad rank high as favorite dishes. But the sea yields a profusion of other food products, equally good and nutritious, that the National Marine Fisheries Service is striving to bring from obscurity to center stage.

With the knowledge that the sea is neither an unlimited nor an invulnerable resource has come the realization that fishery stocks must increasingly be brought under international conservation regulations. And growing consumer demand has sharpened competition for seafood, both on the fishing grounds and in the marketplaces of the world, causing prices to rise. Against this background, fishery research aimed at getting more mileage from available resources has assumed a new urgency.

Experts in the National Marine Fisheries Service are tackling the problem from a number of aspects, all under the general heading of "underutilized resources research." Avenues being explored include development of new fisheries based on untapped resources or on resources not being used to the fullest extent practical; better harvesting methods; improved processing, designed either to reduce waste or increase market acceptance; shifting a species to a more profitable market—for example, using a fish for human consumption rather than livestock feed, fertilizer, or bait; and even altering social attitudes.

Several elements in the Fisheries Service are continually engaged in research and development related to underutilized marine species. Major responsibility rests with the Resource Utilization Office, whose Fishery Products and Inspection Division and Market Research and Service Division play an important part in the initial research and development surrounding the introduction of new varieties or new uses of seafood. In most instances, those divisions will have devoted months or years to studying a potential fish candidate for commercial sale. A considerable contribution is made by the NMFS Resource Research and Resource Management offices—the first in such matters as locating and assessing the abundance of stocks of food fish and investigating potential benefits to be realized from concentration by the fishing industry on various species; the second in affairs concerning State-Federal cooperation in management measures and dissemination of needed information through its Extension Division. NMFS regional laboratories and offices play a continuing part in the cooperative effort to increase the range and variety of fish products available to the U.S. public. NOAA's Office of Sea Grant is sometimes involved in field experimentation, as are various state universities and scientific establishments.

The race to harvest the sea has been erratically paced, at best. In most cases, successful development of a new fishery requires far more than the simple knowledge that a resource exists in a given location. Before committing himself to a course of action, the fisherman wants to be assured that there is a profitable market for his catch and that the resource is plentiful enough to last for a while. It is hardly worthwhile for the distributor to embark on an advertising and consumer-education campaign for a new product unless he is reasonably sure that the housewife will find it a tasty and

* *Rick Guidice is a writer-editor with the National Marine Fisheries Service National Marketing Services Office in Chicago.*

nutritious item to serve her family, and that he will have supplies on hand available to potential customers.

Although resource assessment techniques have improved considerably in recent years, estimates of the standing crop (the number of individuals or the poundage of a particular fish population available in a given area) and the sustainable yield (the amount that can be harvested annually without depleting the resource) are far from precise. Depending on the method used, and on how much is known about the species' behavioral characteristics, life history, and environmental requirements, such estimates can range from specific figures to indefinite expressions such as "on the order of hundreds of thousands of tons."

NMFS uses several methods to gather data for such estimates. The most straightforward approach is to go down and have a look at the resource. This is basically what is done with apparatus such as the Remote Underwater Fisheries Assessment System, called RUFAS. The device is an underwater sled fitted with television and movie cameras. RUFAS has greatly expedited investigation of the calico scallop beds off the east coast of Florida, a resource which remained virtually untouched until the 1960's.

While RUFAS is a valuable aid in relatively clear waters, a system that produces visual information is not much good when visibility is poor, as it often is in the murky waters of the Pacific Northwest. In recent years, acoustical measurements involving the use of sound waves to determine the size and depth of a school of fish have been used with great success on some species. However, since the technique does not differentiate between the seabed and fish on the bottom, it cannot be used to assess groundfish resources.

Scuba divers working from submersibles and in investigative teams are important to undersea fisheries assessments. Some 75 qualified divers work on a permanent basis for NMFS, studying the marine environment on both coasts and in the Gulf of Mexico. Their assignments may range from looking closely at lobsters on the seafloor of the Gulf of Maine, to marking calico scallops in waters off Florida, to seeing how fish react to various kinds of underwater traps and gear in northwest Pacific regions.

The traditional method of assessment, often used in conjunction with acoustical or visual investigation, is for scientists from field laboratories to make trial fishing runs in a given area and then project information obtained from the catch to arrive at an estimate of available resources. But the accuracy of such extrapolation depends on having some idea of how many got away, and fishery scientists regard this as one of the weaker points in resource assessment.

An account of the successful introduction into the American diet of a species of fish called pollock illustrates how NMFS may serve both the public and the fishing industry in an adverse situation. During the 1960's, catch figures for haddock—the mainstay of New England fishermen and consumers for

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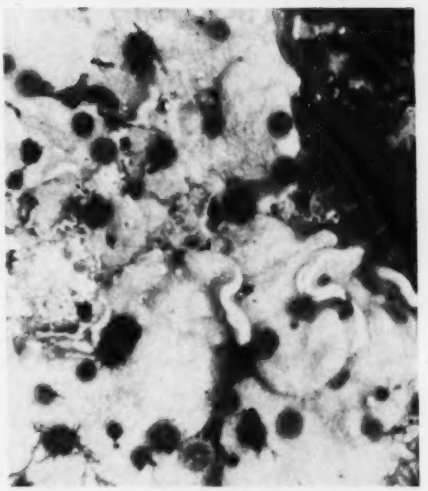


(Top) Fisheries scientists study sea urchins. (Above) The small circular objects are sea urchins, considered a pest because they destroy kelp beds. Now, processors in California are planning to export sea urchin roe to foreign markets. (Left) New England's ocean quahog is being developed as a possible addition to the U.S. seafood market.

(Top) Smoked whiting, a New England product, has been developed from an underutilized resource to an accepted food item. (Above and right) Equipment for separating fish flesh from bones shows promise in increasing utilization, particularly for species with unusually tough or soft flesh.

decades—began to plummet. By 1969, the haddock resource was declared a disaster, and several countries imposed annual catch quotas and closed seasons, set to remain in effect for many years. NMFS scientists and technologists began analyzing the possibilities of finding a satisfactory alternate variety of fish.

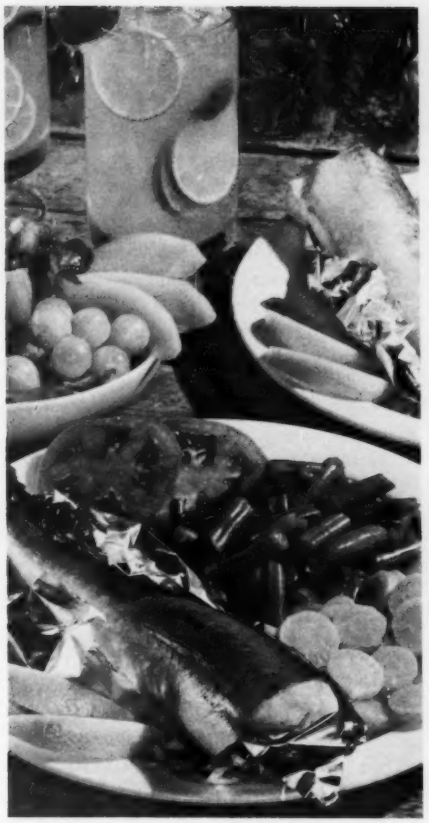
Pollock, a large fish indigenous to the New England coast, similar to haddock, and relatively underutilized at the time, was chosen by the Fisheries Service as a reasonable substitute for the popular haddock. After the abundance, catchability, distribution, and technological factors had been assessed by fishery scientists, a campaign was planned to introduce the plentiful but little-known pollock to consumers. Before the campaign to popularize the "understudy" species was mounted, NMFS personnel enlisted industry support, and organized 1,235 persons into taste panels to ascertain the acceptability of pollock as a food item. The Service then contacted potential purchasers in the food industry and furnished pollock samples for further testing. sent home economists to carry their cookery expertise to radio and television stations and professional food purveyors, and provided recipes and cooking instructions to news outlets. Various NMFS individuals donated their time to participation in complementary State marketing efforts and helped publicize the new market product at ten major food-trade conventions.

Soon pollock was popular in the marketplace. As catches of cod, flounder, and other popular species followed the downward trend of haddock catches in ensuing years, pollock became even more important to New England fishermen and to the fish-eating public. The formerly unappreciated species now has its own identity, sells readily at competitive prices, and fills a void left by diminishing supplies of other food fish.

Smoked whiting, which is also a New England product, gained acceptance through a similar introductory pattern.

Still another New England resource—the small pink shrimp found in the Gulf of Maine—was the object, over the years, of sporadic efforts to begin a fishery. This shrimp (unrelated to the pink shrimp found in the Gulf of Mexico) was cooked whole and sold in some local New England markets, but never really became popular. Not until the late 1960's—when coincidental increases in demand in Europe created an export market—did the present thriving fishery spring into being.

Other seafoods now being developed as possible additions to the American fish market are: The Geoduck (pronounced gooey-duck) clam, a plentiful giant species from Pacific Northwest waters, weighing up to five pounds; the ocean quahog of New England waters, thought to be too strongly flavored until technological processing proved otherwise; the mullet, abundant in southeastern waters, eaten enthusiastically by many southerners, but now known in other regions; and red and Jonah crabs



To increase public acceptance of underused fish species, NMFS home economists develop recipes and give cookery demonstrations. (Above, from left) pollock, whiting, and squid.

caught off New England, but in deeper waters than fishermen cared to work as long as other stocks of seafood were more readily available.

Equipment for separating fish flesh from the bones shows promise as a major tool for increased utilization, particularly for species that have unusually tough or unusually soft flesh, or have considerable meat left on their skeletons after filleting. Minced fish may be adaptable to a variety of uses—including spreads, fish sausages, or fish portions—or formed into frozen pressed blocks, which may be converted to a variety of forms. NMFS is presently engaged in an advisory capacity with a number of commercial companies that are working toward developing or perfecting fish separating machines. The possibilities are highly encouraging.

Improved harvesting techniques or gear can also help reduce waste in resources. For example, cage-like traps, or pots, have been developed for the sablefish fishery of the Pacific Northwest. Before the development of the pots, sablefish were taken either by trawls or by hook and line. Those taken on hooks often were damaged by predators; those taken by trawl could be damaged by the weight of other fish as the net was taken aboard or by rough handling during the sorting operation. The pots are designed to take only sablefish when fished at certain depths, decreasing the possibility of damage during sorting operations and curtailing damage inherent in the trawling or hook-and-line methods. The size of the fish taken also can be regulated by the size of the mesh.

Many possible protein sources, abundant off our shores, are disregarded or shunned simply because there are more traditional choices available. For example, mussels are abundant in U.S. waters, but they are not as popular in this country as they are in Europe. Because squid is a little-known delicacy among Americans, most of the U.S. catch is used by ethnic groups only or exported. Fishery scientists point out, however, that just because a resource is not being taken to any degree by U.S. fishermen, it is not necessarily underutilized. Japanese fishermen pursue the squid resource off both the Atlantic and Pacific coasts.

In California, processors are attempting to turn a pest into export profits. The plentiful red sea urchin is a voracious destroyer of the state's coastal kelp beds which provide food and shelter for many marine animals, including the delicious and high-priced abalone. Consequently, the harvest of urchins is expected to provide ecological as well as financial benefits. Only broad-minded gourmets fancy sea urchin roe in this country, but it is highly popular in France, Italy, Japan, Chile, and Hawaii.

On this side of the Atlantic, dogfish sharks are disliked because they damage expensive nets, and are rejected as trash fish. In European countries, the same creature is a sought-after delicacy. Although slow growth and a low rate of reproduction weigh against the value of a large and sustained fishing effort, scientists feel dogfish might support a fairly substantial fishery.

For many years the production of croakers was centered in the mid-Atlantic and Chesapeake Bay area. In recent years, however, a large croaker resource has been known to exist in the Southeast and in the Gulf of Mexico, and fishermen are now seeking new markets for the species. In this case, they may be in luck. Partly because of the inclusion of small shellfish in the croaker's diet, their flesh has a light shellfish flavor and good consistency. This makes for good consumer acceptance, and so does the fact that croakers recently have been made available in a guaranteed-boneless, fish cake form.

Together, scientists, technologists, and fishermen continue seeking ways to satisfy the consumer's appetite for fish. And underutilized marine resources constitute the most obvious and viable answer to problems of depletion in popular species, and the question of how to satisfy the growing demand for seafood. □

GATE TO UND

From June 15 to September 30, 1974, one-third of the earth's tropical belt will be under intensive observation in the largest and most complex international scientific experiment ever undertaken.

Some 25 to 30 ships, a dozen aircraft, and 75 to 100 land stations, as well as satellites and instrumented ocean buoys, will be gathering data over the tropical Atlantic and adjacent land areas for a study of the behavior of cloud clusters and their role in the larger circulation of the atmosphere.

Called GATE—for GARP Atlantic Tropical Experiment—the planned project is the first major international field experiment in the Global Atmospheric Research Program of the World Meteorological Organization and the International Council of Scientific Unions. Coordination of United States participation in the experiment is assigned to NOAA.

The GARP Atlantic Tropical Experiment follows Bomex (Barbados Oceanographic and Meteorological Experiment) in a succession of experiments designed to gain increased understanding of the atmosphere and the causes of climatic variation and change. This knowledge is needed for the development of numerical models for long-range weather prediction and for assessing the long-term effects of pollutants on the atmosphere. The Bomex project, conducted by the United States in the Atlantic east of Barbados in 1969, examined the small-scale exchange of energy between sea and air. GATE will seek to learn how cloud clusters in the tropics transform and redistribute energy within the atmosphere. After GATE, an international global observing experiment (First GARP Global Experiment) is scheduled to be conducted about 1977, to provide the necessary data for developing, testing, and improving the global mathematical models which are the fundamental tools for understanding and predicting the long-term behavior of the atmosphere.

A major international field experiment is being mounted for 1974, to examine the tropical atmosphere and ocean

The tropics receive a disproportionately large share of the heat input from the sun which fuels the circulation of the entire atmosphere. Vast quantities of heat and moisture, stored in the oceans, are transferred from sea to air and then are carried upward by tropical convective systems ranging in size from the single cumulus cloud to the hurricane. In these organized systems, heat and moisture are transported to higher latitudes and ultimately effect the atmosphere over the entire earth.

Meteorologists today have a reasonably clear understanding of the processes involved in the large-scale behavior of the atmosphere in middle and high latitudes. Applying this knowledge, they have developed and are continuing to improve mathematical models for use in computerized weather prediction. But a major obstacle to the development of reliable computer predictions of weather a week or more ahead is the lack of understanding of tropical weather systems and their effects on global circulation.

Therefore, the primary objective of the GARP Atlantic Tropical Experiment is to gain the increased knowledge of the meteorology of the equatorial belt needed to understand the atmospheric circulation as a whole. Such knowledge would then be used to advance understanding of tropical meteorology, hurricanes, and other storms, to improve forecast techniques for equatorial regions, and to develop the models and observing system needed to provide reliable numerical forecasts for a week or two in advance.

Although the surface of the tropical ocean is relatively homogeneous over broad areas, the cloud systems which transport heat and moisture from near the surface to higher levels are well-organized. Smallest of these are the individual cumulonimbus cells up to 10 kilometers across, which are often found in rings or lines extending as far as 100 kilometers. The rings or lines cluster to form larger systems—sometimes called "cloud clusters."

Satellite photographs show that tropical convection regularly occurs in cloud clusters. GATE is being designed to describe the internal structure and life cycle of the clusters and to relate them to larger events in the tropical atmosphere, such as the atmospheric waves which move from east to west across tropical regions.

Although the initial impetus for GATE stemmed from atmospheric objectives, the experiment also will include an oceanographic program. GATE offers a virtually unprecedented opportunity, probably unique in the foreseeable future, to study tropical ocean phenomena which are inherently coupled to the atmospheric processes to be observed during the experiment.

The oceanographic program, developed by a task group under the National Academy of Sciences' Ocean Science Committee, focuses on two aspects with broad scientific and practical importance. The first is the complex equatorial current system, closely related to oceanic upwelling processes and to the atmosphere's intertropical convergence zone. Understanding of this major feature of oceanic circulation is vital to the development of ocean models. The second focus of the oceanographic program is the interaction of the ocean's upper layers with the atmosphere and organized convective systems of the scale under study in the GATE project.

The goals of GATE require a farflung observing network to define the large-scale atmospheric disturbances, as well as a dense network to examine the internal structure of cloud clusters and their effect on the immediate environment. To provide the required observations, a composite network has been designed, including geostationary and polar-orbiting satellites, an augmented World Weather Watch network of land stations, a special network of ship stations, instrumented aircraft, and balloon and buoy systems.

The GATE experimental area will extend approximately from the west coast of Latin America to the east coast of Africa, between latitudes 10 degrees South and 20 degrees North. At the western end the area extends to 24 degrees North, to permit inclusion of reports from existing coastal and island stations in the Caribbean and part of the Gulf of Mexico.

To define the significant features of large-scale circulation in this area, land stations are planning to make surface observations and two upper-air soundings per day. The existing network of land stations is being augmented under the World Meteorological Organization's Voluntary Assistance Program, and temporary or mobile stations may be added to provide the coverage required by the GATE project. Over the tropical Atlantic Ocean, ships will be deployed to make surface and upper-air observations. Satellites will observe the entire area, night and day.

DERSTANDING

BY ANN K. COOK

Within the larger experimental area, a more intensive study of cloud clusters will be conducted in the eastern Atlantic, about 1000 kilometers from the African coast. Here, ships will be stationed in a pentagonal array, a shape resembling the simple outline of a house with the roof peak at 15 degrees North and its base at 5 degrees North. The array will cover an area of about 500,000 square kilometers, where cloud clusters occur frequently during summer months. Clusters will be observed in detail by ships in the array and by reconnaissance aircraft.

Nations planning to commit ships to the experiment are Brazil, Canada, Colombia, France, the Federal Republic of Germany, Mexico, the Netherlands, Portugal, the Union of Soviet Socialist Republics, the United Kingdom, the United States, and Venezuela. All participating vessels are expected to be equipped for upper-air soundings of wind, temperature, and humidity; surface weather observations; and sea surface temperature measurements. Many will measure ocean temperature and salinity with depth.

Vessels comprising the eastern Atlantic array will be more elaborately instrumented, with radar to measure the location, extent, and rate of precipitation, and with equipment for radiation, boundary layer, and oceanographic observations. These ships will make regular surface observations and upper-air observations at six-hour intervals, with more frequent measurements during disturbed periods.

The United States will contribute at least five vessels to the GATE experiment, including the NOAA Ships OCEANOGRAPHER and DISCOVERER; the University of Miami's Research Vessel GILLISS, sponsored by the National Science Foundation; and a high-endurance Coast Guard cutter. The NOAA ships and the R/V GILLISS each will be equipped with a Boundary Layer Instrumentation System—a tethered balloon instrumented for atmospheric measurements at five levels—and a mounted boom instrumented to measure near-surface radiation, humidity, and temperature. They also will carry special shipboard systems for recording, processing, printing, and plotting data gathered by shipbased instruments. In addition, each of these vessels will have a C-band radar which will be used to detect rainfall as far as 200 miles away.

Still under development for possible use in GATE is a buoy to be tethered to ships, to measure near-surface winds and temperature away from the vessels' immediate environment.

For upper-air soundings, all U.S. vessels will use Omega wind-finding techniques, in which navigation signals are received at the balloon and transmitted to the shipboard tracking station, for use in determining the path of the balloon's movement and deriving the speed and direction of the wind.

The United States is considering the possibility of providing a number of moored limited capability buoys, now being developed by NOAA's National Data Buoy Center, for the experiment. Instruments especially designed for the needs of the experiment would be mounted on the buoys to measure ocean current, temperature, and salinity, as well as surface meteorological parameters.

At least 13 aircraft are expected to be available for GATE, provided by Brazil, the Federal Republic of Germany, France, the Union of Soviet Socialist Republics, the United Kingdom, and the United States. All aircraft are expected to be capable of flight-level wind and thermodynamic measurements, and a few will be equipped for cloud photography and measurements of turbulent fluxes, sea surface temperatures, radiation, and liquid water content of the atmosphere. In conjunction with shipboard radar and data from a geostationary satellite, the planes will be used to investigate organized convective cloud systems in more detail than is possible from the ship network. U.S. aircraft scheduled to participate in the experiment are the C-130 from NOAA's Research Flight; an Electra-type plane to be operated under lease by the National Center for Atmospheric Research; the National Aeronautics and Space Administration's Convair 990; an aircraft from the Air Force's Air Weather Service; and three shortrange planes from the National Center for Atmospheric Research—a Buffalo, a Queen Air, and a Sabreliner.

A key element in the experiment will be the Geostationary Operational Environmental Satellite, providing nearly continuous images, day and night, of cloud cover over an entire hemisphere, information on surface temperatures, and collection and transmission of data. One GOES spacecraft is scheduled for launch in October 1973, and another early in 1974.

Stationed over the equatorial Atlantic, GOES will view the entire GATE experimental area as often as every 20 minutes. Its images will be used in directing ship and aircraft operations, and will furnish large-scale data. Cloud movements shown in a series of images will be analyzed to determine the speed and direction of winds. The satellite's data collection capability will be employed to collect data from observing platforms. GOES also may be used to transmit facsimile data to the GATE Operations Control Center.

Polar-orbiting satellites expected to be operating during the GATE project are the United States' NOAA series and the Soviet Union's METEOR spacecraft. NOAA satellites will provide day and night images and vertical temperature profiles, while the METEOR vehicles will furnish direct television and infrared cloud images over the experimental area. Experimental satellites which may be available during GATE include two U.S. Nimbus spacecraft equipped for advanced infrared, microwave, and radiation soundings, and a Soviet satellite capable of sensing vertical temperatures in the atmosphere.

Present plans are to begin the GATE project with several days of trial runs and intercomparisons of the various observing systems. Thereafter, three 21-day observing periods will be conducted, with the ships returning to port between phases.

The majority of the ships and aircraft participating in GATE are expected to operate from Dakar, Senegal, although some ships stationed in the western Atlantic would use island or South American ports.

A GATE Operations Control Center, planned for Dakar, will serve as the nerve center for daily operations during the experiment. The Center's international staff will communicate with ships and aircraft, control mission schedules, plan aircraft operations, monitor platform status, participate in preparation of special forecasts, collect and relay data from ships and aircraft, interpret satellite images,

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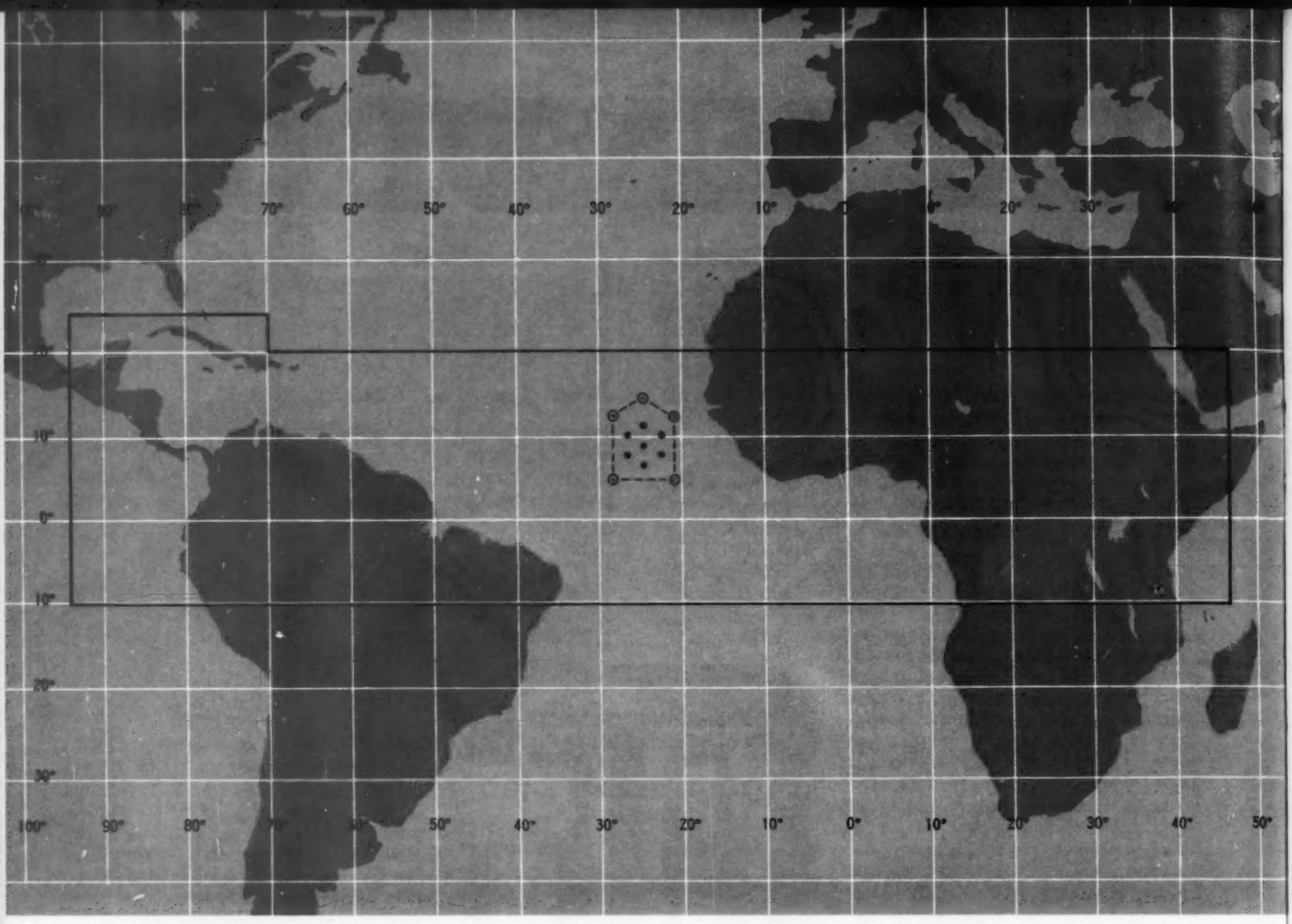


radar, and aircraft data, perform quality control, perform preliminary scientific analyses, and provide support services for experimental operations in the eastern Atlantic.

A Regional Meteorological Center and Regional Telecommunication Hub already have been established at Dakar as part of the World Weather Watch, and will make regional and global weather analyses and forecasts readily available to the Operations Control Center. In addition to collecting data gathered by participating ships, aircraft, and buoys, the Center will receive GOES images directly from the spacecraft through a GOES ground station, to be installed at Dakar for the duration of the experiment and then removed for use in NOAA's field service network. Weather analyses, satellite images, and data from the observing platforms will be used by the Control Center in directing the experiment and checking the performance of observing systems.

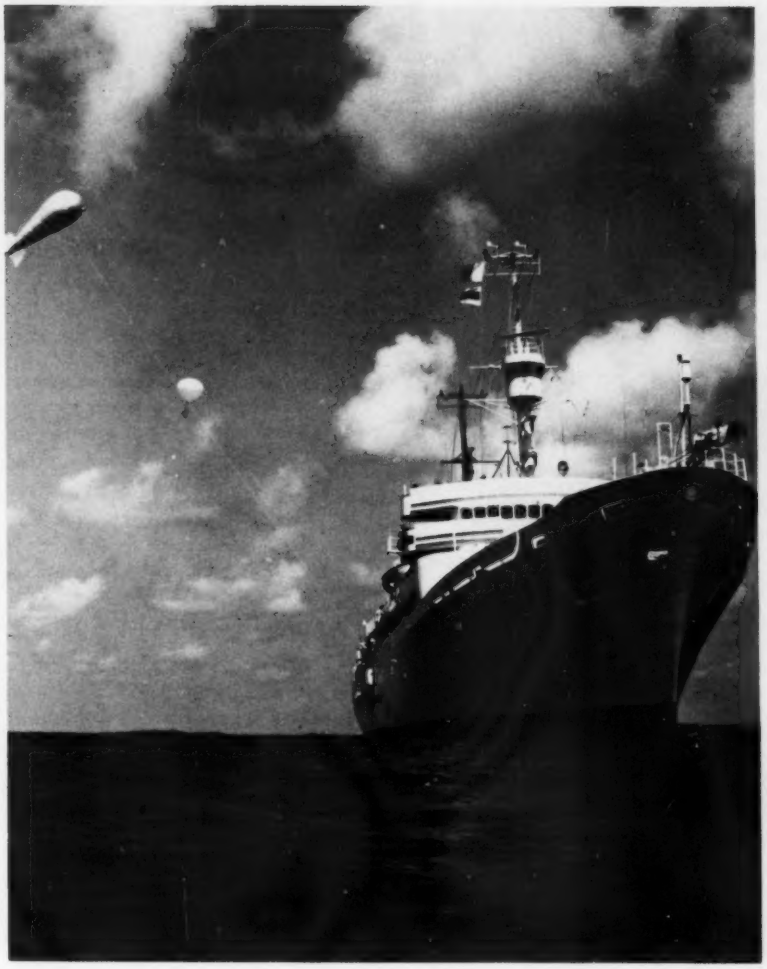
A GATE Data Center will be established, probably at the Bracknell, England, headquarters of the United Kingdom Meteorological Office. Each participating nation will process the data it collects and turn it over to the GATE Data Center, which then will catalog, integrate, validate, and reformat the national data sets. The resulting complete GATE data set is expected to be available for archiving at World Data Centers about two years after completion of the experiment.

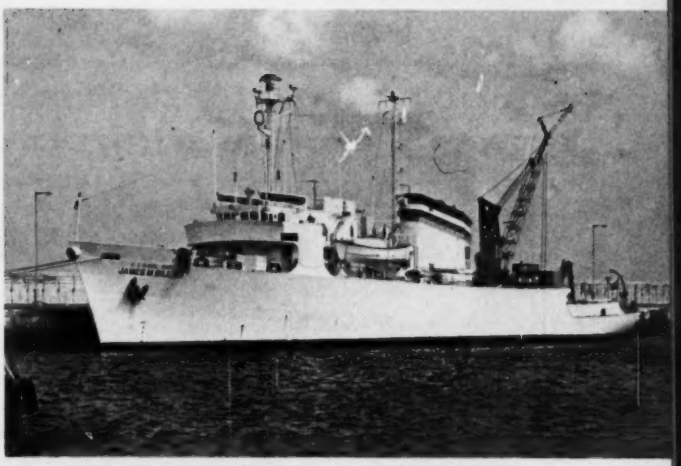
In order to ensure the comparability of data gathered by such a wide variety of national platforms, a number of preliminary calibration and intercomparison tests are planned. For example, shipboard hardware designed for the experiment will be installed on the NOAA Ship DISCOVERER and tested during a research expedition beginning this month (January 1973). In the summer, an intercomparison test of instruments aboard the DISCOVERER and ships of the Soviet Union is planned for the tropical Atlantic. A preliminary test of land observing facilities also is scheduled for the summer of 1973.

Overall management of this complex international undertaking is the responsibility of the Tropical Experiment Board, representing nations making substantial contributions to the experiment. Present members of the Tropical Experiment Board are Canada, Finland, France, the Federal Republic of Germany, the Netherlands, Portugal, the Union of Soviet Socialist Republics, the United Kingdom, and the United States.

An International Scientific and Management Group responsible to the Board is serving as the international project office for the experiment, supervising detailed arrangements for planning and implementation. Director of this group, appointed by the Secretary-General of the World Meteorological Organization, is Dr. Joachim P. Kuettner, former Director of Advanced Research Projects at NOAA's Environmental Research Laboratories. Dr. J. V. Tarbeev of the U.S.S.R. is Deputy Director of the International Scientific Management Group. Dr. Kuettner and Dr. Tarbeev are being assisted by a group of scientists from participating countries, working at Bracknell, England, and at World Meteorological Organization headquarters in Geneva, Switzerland.

A Tropical Experiment Council—representing all interested countries, including those over whose territory the experiment will





(Opposite page) One-third of the earth's tropical belt will be under intensive observation in the GARP Atlantic Tropical Experiment. Within the larger area, a more intensive study of tropical cloud clusters will be conducted near the coast of Africa. (Left) NOAA vessels and the R/V GILLISS will be part of the eastern Atlantic ship array and will be equipped with tethered balloons similar to those used in the Bomex project. (Top right) The University of Miami's Research Vessel GILLISS was a U.S. Navy ship when it participated in Bomex. (Bottom right) The National Aeronautics and Space Administration's Convair 990 is one of the long-range aircraft to be used in GATE.

be conducted—is responsible for the operation and upgrading of land stations in the experimental area in the context of the World Weather Watch. The Council also reviews experiment plans and advises on how the GATE project can best contribute to the improvement of weather services in the experimental area.

Scientific advice is provided to the Tropical Experiment Board and to the Council by the Joint Organizing Committee for the Global Atmospheric Research Program, established by the World Meteorological Organization and the International Council of Scientific Unions.

NOAA's Office of Environmental Monitoring and Prediction, under Associate Administrator Richard E. Hallgren, coordinates U.S. activities related to the World Weather Program, which includes the World Weather Watch, Global Atmospheric Research Program, and Technological Development Program. Participation of U.S. agencies in the GARP Atlantic Tropical Experiment is coordinated by the U.S. GATE Project Office, headed by Dr. Douglas H. Sargeant.

In its preparations for the experiment, the GATE Project Office is supported by other NOAA units. Two of these—Field Research Projects and the Systems Engineering Group—are, like the GATE Project Office, within the Office of Environmental Monitoring and Prediction. The Systems Engineering Group, headed by Orville Scribner, is developing, procuring, and testing instrumentation systems to be used on NOAA ships and aircraft. Field Research Projects, led by William S. Barney, is responsible for field operations and logistics.

The Environmental Data Service's Center for Experiment Design and Data Analysis, directed by Dr. Joshua Z. Holland, is planning and will perform a major part of the processing and analysis of data gathered by U.S. platforms during the experiment.

In addition to operating the satellite system which will provide data for GATE, the National Environmental Satellite Service will install and operate a GOES ground station at field headquarters, and will process and archive the satellite data.

Many scientists from several of the Environmental Research Laboratories and from the National Weather Service's National Hurricane Center will participate as investigators in the experiment. □

NOAA Profile

The National Ocean Survey has a vital role in the new era of ocean exploration, says Rear Admiral Allen L. Powell,

The Eighteenth Director

BY RAYMOND WILCOVE

It cannot be said that Rear Admiral Allen L. Powell was born in a log cabin and then rose to become the head of the nation's oldest scientific agency, but he came close to doing just that.

For the Director of NOAA's National Ocean Survey was born in a frame dwelling in a logging camp in Nacogdoches County, Texas, a transient community of some 200 to 250 souls, where his father, Joe Allen Powell, worked for a lumber company. Here he spent the first three years of his life.

The logging camp was known as a "front," because it was located in a forest at the end of a railroad on which flatcars would carry logs to the sawmill for conversion into lumber.

When Powell was about three years old, his family moved to Keltys, a community of several hundred people, where his father managed the lumber company's store, and from there four years later to neighboring Lufkin, another small community. Here he grew up and graduated from high school in 1932.

The world Powell graduated into didn't look too bright. About 12 million wage earners were unemployed, and many who worked did so for meager pay. Powell recalled that in 1932 laborers at sawmills in the area worked for 10 cents an hour, netting six dollars at the end of a six-day, 60-hour week. Company housing was free, but not food, and many grew their own fruit and vegetables.

Powell spent the next six years after high school graduation continuing his education, trying to find his place in society. "Like many young men at the time," he said, "I didn't know what I wanted to do. I went to the John Tarleton Agricultural and Mechanical College in Stephenville, Tex., for a year, then thought perhaps I'd become an accountant or something and attended a business school for another year.

"I was floundering," continued Powell. "I decided perhaps I'd become an engineer, so I spent the next year at the Schreiner Institute in Kerrville, Texas."

After a year at Schreiner Institute, Powell enrolled at the University of Texas. His major study was petroleum engineering. "I was after some of that black gold," he said, "but when I got my degree in 1938, there were no jobs."

So he returned to his home town of Lufkin, became a substitute rural mail carrier, and took over the family grocery business for a time. When the Southland Paper Mill came to the area, he went to work there as a "fifth hand" on the paper machine and, by 1942, had risen from "fifth hand to "third hand." By then he was supporting his wife, Neta, and a son, Allen, Jr., on about $66.00 a week.

One day, while in the Lufkin post office, scanning the bulletin board where government jobs were listed along with the photos of wanted criminals, he saw a Civil Service announcement for the Coast and Geodetic Survey, the predecessor of the National Ocean Survey.

"I took the Civil Service exam, and the next thing I knew my family and I were with a triangulation survey party in Ballston Spa., N.Y. We spent the next two years with a geodetic survey party, traveling from New York to Connecticut, Mississippi, Alabama, Michigan, and Ohio."

Powell credits Captain Fred Natella, now retired, his Chief of Party, with inducing him to join the Commissioned Corps. "I took a pay cut to join the Corps," said Powell, "and at that I wasn't really in the Corps. I was a deck officer. They don't have that category any more, but in those days it was an interim appointment before you were sworn in as an ensign." Powell served on the Coast and Geodetic Survey Ship COWIE, then working out of Cambridge, Md., conducting hydrographic surveys in Chesapeake Bay.

"I was in charge of launch hydrography," he said. "There were three to four people under me on the launch, and they all knew more hydrography than I did."

(Above) At home in Vienna, Virginia, Admiral Powell relaxes by hooking rugs. (Left) the admiral and Noah, the family cat, on another rug handmade by the National Ocean Survey Director.

Did Powell have any intention at the time of remaining in the Coast and Geodetic Survey? "I didn't have any plans to stay in, and I didn't have any plans to leave," he commented. "Looking back, though, staying in was a good decision. I've enjoyed every assignment I ever had."

For the next 24 years, from 1944, when he became a deck officer, until 1968, Powell performed the normal duties of a Coast Survey commissioned officer (with time out in 1945–46 for service with the Marine Corps in the Pacific as Regimental Survey Officer), with recognition from time to time for special services rendered the government.

Field assignments included shipboard duty on the C&GS Ships COWIE, LYDONIA, the PARKER, BOWEN, and STIRNI (wire drag vessels), PIONEER, BOWIE, and EXPLORER. He spent 2½ years with photogrammetric and geodetic field survey parties. A major geodesy assignment consisted of duty with a special survey group based at Patrick Air Force Base, Fla. In charge at the time was Harley D. Nygren, who turned over the party several months later to Powell. In time, both men would achieve two-star rank. Nygren is now Director of the NOAA Commissioned Corps. Powell headed the survey party for over three years. Its function was to make precise geodetic measurements for the Air Force Missile Test Center. For his work here, Powell received in 1961 the Department of Commerce Silver Medal, its second highest award.

Upon his return to Washington in 1963, after a two-year tour aboard the EXPLORER, Powell joined the New Ship Staff and then went on to become Chief of the Ship Facilities Group and, when it was reorganized in 1965, Chief of the Ship Construction Group. In 1968, he was awarded the Commerce Department's Gold Medal, its highest award, for pioneering "a new concept in the design and construction of oceanographic vessels used in the C&GS Continental Shelf Program."

August 7, 1968, is a day that is forever fixed in Powell's mind, for it was then, while on a trip to Seattle, Wash., that he was stricken with a heart attack. His one thought then was to get back to his family in Virginia. "I wasn't about to have them come running to Seattle, perhaps spending months there while I lay in a hospital," he said.

So he took the next plane back to Washington. There they carried him off directly to a hospital. That's another date Powell won't forget, August 8, the day he entered the hospital.

"Things didn't look too bright then," said Powell. It was an understatement, because Powell didn't know whether he'd ever be able to go back to his job. But he did, returning to work first gradually, late in October of that year, and then full time. By then he had lost 35 pounds and his 5′11½″ frame was down from 185 to 150, where he has kept it since. He gave up smoking, and adopted a low-fat diet. "I feel fine now," he said, "but I watch myself."

From then on, the fates turned and his rise up the ladder was rapid. In January 1969, he became Director of NOAA's Atlantic Marine Center in Norfolk, Va., a position which carried with it a promotion in rank to rear admiral. The boy who had been born in a logging camp had become a flag officer in one of the nation's uniformed services.

Three years to the month after he suffered his heart attack,

continued

NOAA Administrator Robert M. White selected Powell to head the newly created Office of Fleet Operations, established to operate the 27-ship NOAA Fleet, including some of the nation's most modern and sophisticated oceanographic and fisheries research vessels.

The following year, upon the retirement of Rear Admiral Don A. Jones, the Secretary of Commerce, on the recommendation of Dr. White, named Powell to succeed him and on May 18, 1972, the small town boy from Nacogdoches County, Texas, became the 18th head of the agency founded in 1807 by President Thomas Jefferson.

Looking back over three decades to the day he walked into the Lufkin post office and saw the Civil Service announcement on the bulletin board, Powell is struck by the changes that have occurred in the intervening years in the organization he now heads.

"We are in the middle of an oceanographic explosion in which our agency is doing work vital to the nation," he stated. "When I reported aboard the COWIE in 1944, hydrographic surveys were probably our most important task. They're still important, but there are many more things to which we must lend our time, our efforts, and our skills.

"I can recall," he continued, "when I was aboard the LYDONIA, they didn't even have radar. Today, such ships as the OCEANOGRAPHER, DISCOVERER, and RESEARCHER each carry millions of dollars worth of scientific and electronic equipment aboard. Our ships are highly automated, comprising one of the most modern oceanographic research fleets in the world. They were built and designed for the work they engage in, not like the earlier days when we did the best we could with converted craft, including former yachts and military craft. This is a new ballgame, and I'm convinced that NOAA and the National Ocean Survey are going to play a major role in it.

"One of the major aspects of our work in oceanography," said the Director, "and one which I am convinced will continue to grow, is the tremendous requirement for data, for the information necessary to make the decisions the nation will be required to make in the development of the Continental Shelf, with all its submerged wealth, and in fighting pollution of our coastal waters, bays, and estuaries.

"What do we do about the problems raised on our waterways and coasts by the construction of atomic energy plants? What about oil spills? What about the building of deep-water ports? All require the data and end products that NOAA produces. We're entering a new era of ocean exploration and development, with all the promises and perils that go with it, and NOAA and NOS will have important contributions to make."

The population explosion, added the Director, has also brought with it an increasing awareness of the importance of the work being done by the National Geodetic Survey. Urban centers are pressing for more accurate geodetic controls, essential for the development of new housing projects, highways, and the establishment of accurate tax records, to name but a few. "Within our budgetary and manpower limitations, we will do our best to help them," said Powell.

Hydrographic surveys will play an increasingly important role, said Powell, in navigational safety as recreational craft continue to increase. Powell predicted that the government eventually will require most craft to carry nautical charts. Many of them do not now.

As for the ships which carry out hydrographic surveys, and the others as well, "something new will be added," predicted Powell, "and I'm not talking about further automation.

"I'm talking about women," said Powell, not unaware of the fact that it was under him as Director that the first woman commissioned officer was assigned to a NOAA ship. Powell said the number of women aboard the ships, both commissioned and civilian, would increase in the years ahead. He predicted the time will come when women will serve as commanding officers of NOAA ships.

"I don't see any limitations to what a woman commissioned officer can aspire," he declared. "There is no reason why women cannot perform as well as their male counterparts; and merit the rewards, and responsibilities that go with the job."

As for the NOAA Commissioned Corps, Powell felt it still holds out a promising future for college graduates, despite the lure of industry and other pursuits.

"It depends, of course, on each individual and what he or she is seeking out of life," said the Director. "For some, the hope of greater financial rewards causes them to seek a future in business or in some other endeavor outside the Corps. But for those who would like to explore the wide variety of disciplines that NOAA offers, including the opportunity to command modern vessels and participate in program areas in responsible positions, a career in the Commissioned Corps can be very promising and satisfying."

Looking ahead, Powell thought the future of his organization "has never looked brighter.

"The services and products that we furnish are vital to the well-being and economy of the nation," he said. "We have a long history of excellence and performance and dedication. I have confidence this will continue."

Powell and his wife, the former Neta Menefee of Lufkin, Texas, reside in Vienna, Va. Their son, Allen, Jr. lives in Moscow, Idaho, and a daughter, Mrs. Leilani Ann Grimm, in Vienna, Va. □

Admiral Powell enjoys his home workshop, where he is repairing a lamp.

Launch of the new operational spacecraft, NOAA-2, marks a major advance in environmental monitoring.

THE 3-D SATELLITE

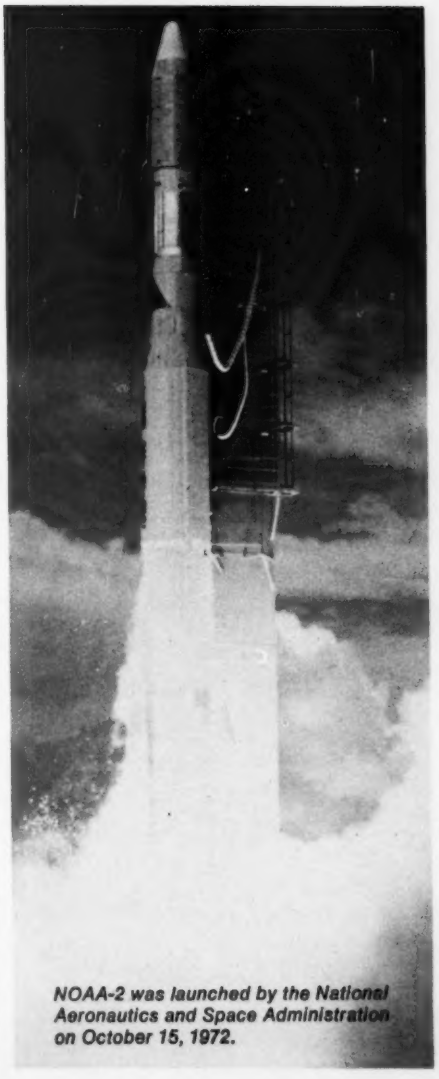
Though it hasn't a single camera, the NOAA-2 operational satellite is taking "pictures" of the atmosphere and oceans all over the earth twice each day, in daylight and in darkness.

Even before launch, it was dubbed "the 3-D satellite," because of its ability to furnish soundings of atmospheric temperatures as well as images of cloud cover.

Launched by the National Aeronautics and Space Administration on October 15, from the Western Test Range in California, the spacecraft attained a nearly perfect orbit —with an apogee of 785 nautical miles, a perigee of 782 nautical miles, and a drift of two minutes per year—the best ever for an operational environmental satellite. After checkout by NASA, operational control of the spacecraft was turned over to NOAA's National Environmental Satellite Service on November 8, and on November 17 it became the primary spacecraft in the operational environmental satellite system.

NOAA-2 gathers and transmits weather and ocean information never before available on an operational basis. Although similar in appearance to previous satellites in the ITOS series, it is the first to fly with no cameras aboard and to rely entirely on scanning radiometers for imagery. It is also the first operational satellite to carry a sensor to obtain vertical temperature profile soundings of the atmosphere routinely on a near-global basis.

The 40x40x49-inch box, with a three-panel solar cell array attached, contains instruments flown on earlier ITOS satellites—the two-channel scanning radiometer and the solor proton monitor—and two new sensors flying for the first time on the operational satellites—the vertical temperature profile radiometer and the very high resolution radiometer. Duplication of all sensors in the spacecraft ensures a more reliable service and longer lifetime.



NOAA-2 was launched by the National Aeronautics and Space Administration on October 15, 1972.

The scanning radiometer system, similar to that on NOAA-1, gathers data in both visible and infrared channels. The visible channel observes only sunlit portions of the earth, while the infrared channel furnishes cloud pictures both night and day. The radiometer scans a 2000-nautical-mile-wide swath beneath the satellite's path. Picture resolution directly beneath the satellite is two nautical miles in the visible channel and four nautical miles in the infrared.

The scanning radiometer replaces the two types of camera systems formerly carried on operational satellites. It provides both stored picture coverage of the earth's weather and direct transmission of cloud cover photographs from the satellite to local receiving stations around the world. Its ability to photograph the dark side of the earth makes nighttime satellite observations available to National Weather Service forecast offices throughout the nation for use in preparing early morning forecasts and ensures night as well as daytime coverage of hazardous weather, such as hurricanes and winter storms.

The very high resolution radiometer obtains observations similar to those taken by the scanning radiometer, but with a resolution of ½ mile in contrast to the 2-to-4-mile resolution of the scanning radiometer observations. Limited amounts of the VHRR data are stored for selected areas along the orbit, but the instrument operates primarily in a direct readout mod transmitting data as it is taken to relatively complex "S-band" receiving stations. NOAA stations located in Gilmore Creek, Alaska, Wallops Station, Virginia, and Redwood City, California, are equipped to acquire the VHRR observations.

In addition to providing images of cloud cover, the scanning radiometer and the VHRR obtain a measure of the sea surface temperature in cloud-free areas. Observa-

continued

tions from the scanning radiometer are used to produce daily global analyses of the sea surface temperature for use in a number of weather and marine environment forecast services. The temperature of the sea surface affects the way in which weather systems develop and move over the ocean areas toward populated land areas. Also, the sea surface temperature patterns can show the location and some detail about ocean surface currents which are of interest to shipping.

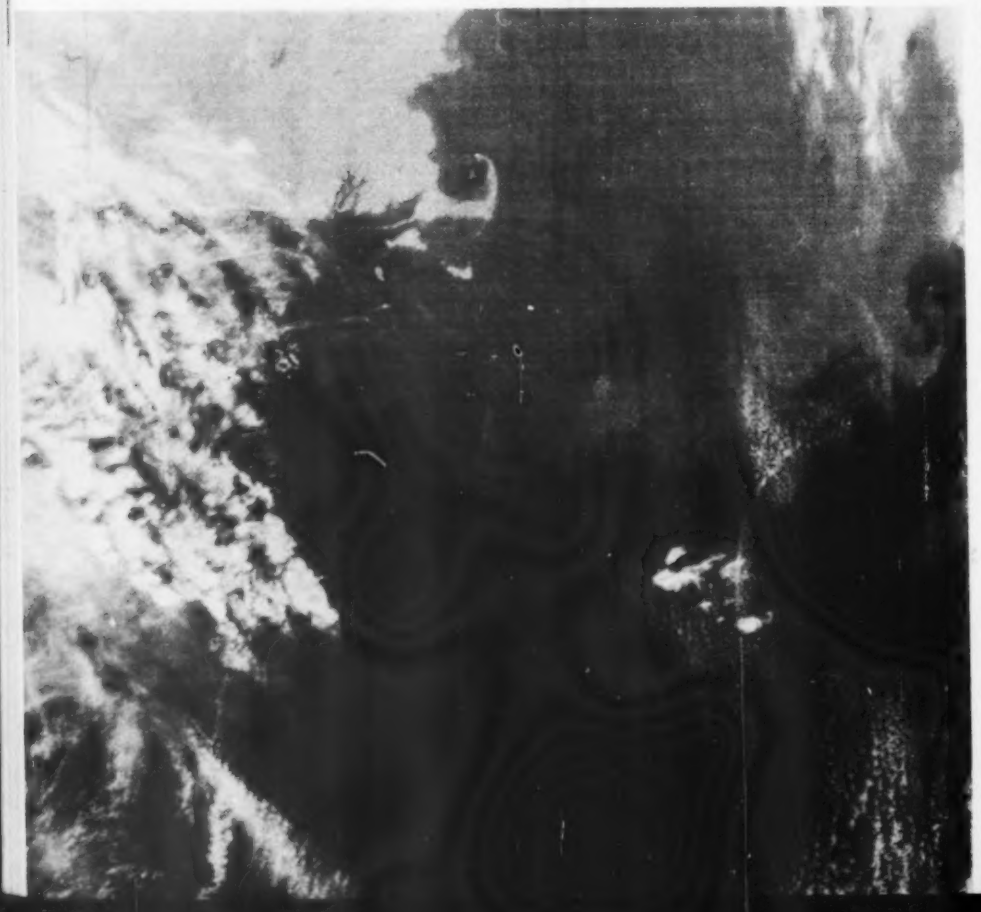
Using data from the VHRR, the Satellite Service is refining techniques for producing high-resolution sea surface temperature analyses for selected areas where such information is particularly useful for fisheries interests, for monitoring the circulation in bays and estuaries for pollution control, and for better understanding of ocean dynamics. In addition, the VHRR observations of ice on oceans, lakes, and rivers provide useful information to navigation, and its high resolution observations of the snow pack in remote areas are expected to assist hydrologists in providing a more reliable assessment of flood potential.

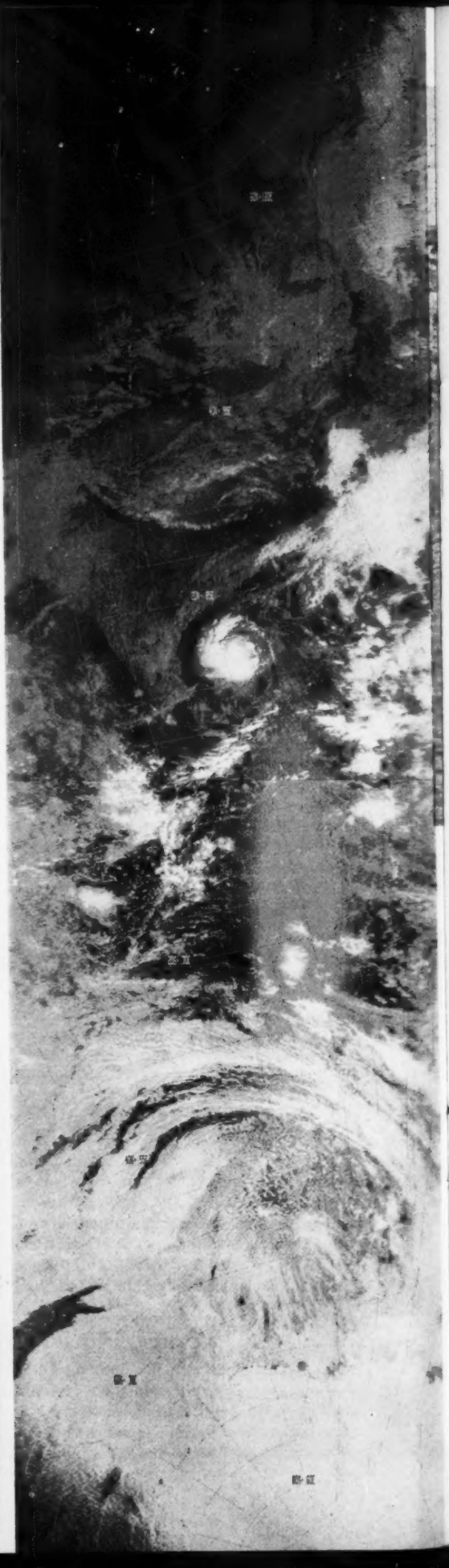
The vertical temperature profile radiometer is an instrument that measures infrared energy radiated at six levels of the atmosphere and at the earth's surface or cloud tops. These measurements are used to calculate the vertical temperature distribution—or profile—of the atmosphere beneath the satellite. The radiometer also provides information on the total moisture content of the atmospheric column observed.

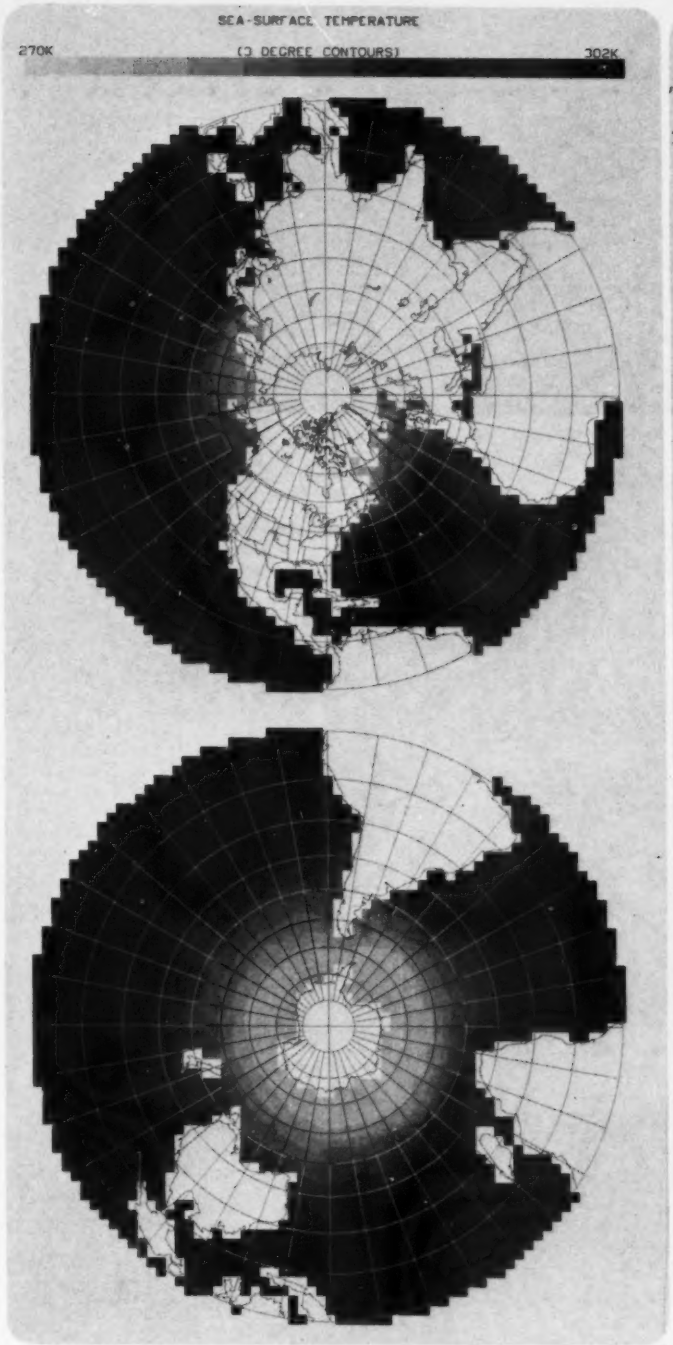
Operational use of the new radiometer is a major advance in NOAA's continuing effort to provide meteorologists with the quantitative global measurements of atmospheric pressure, temperature, moisture, and wind needed for computer weather forecasting. Before the launch of NOAA-2 such information was available from only 20 percent of the earth; the remaining 80 percent—mostly over the oceans and in the Southern Hemisphere—was inadequately observed by conventional techniques. Satellites, carrying instruments such as the vertical temperature profile radiometer, offer a practical means of gathering global atmospheric measurements and of delivering the data to weather forecasting centers.

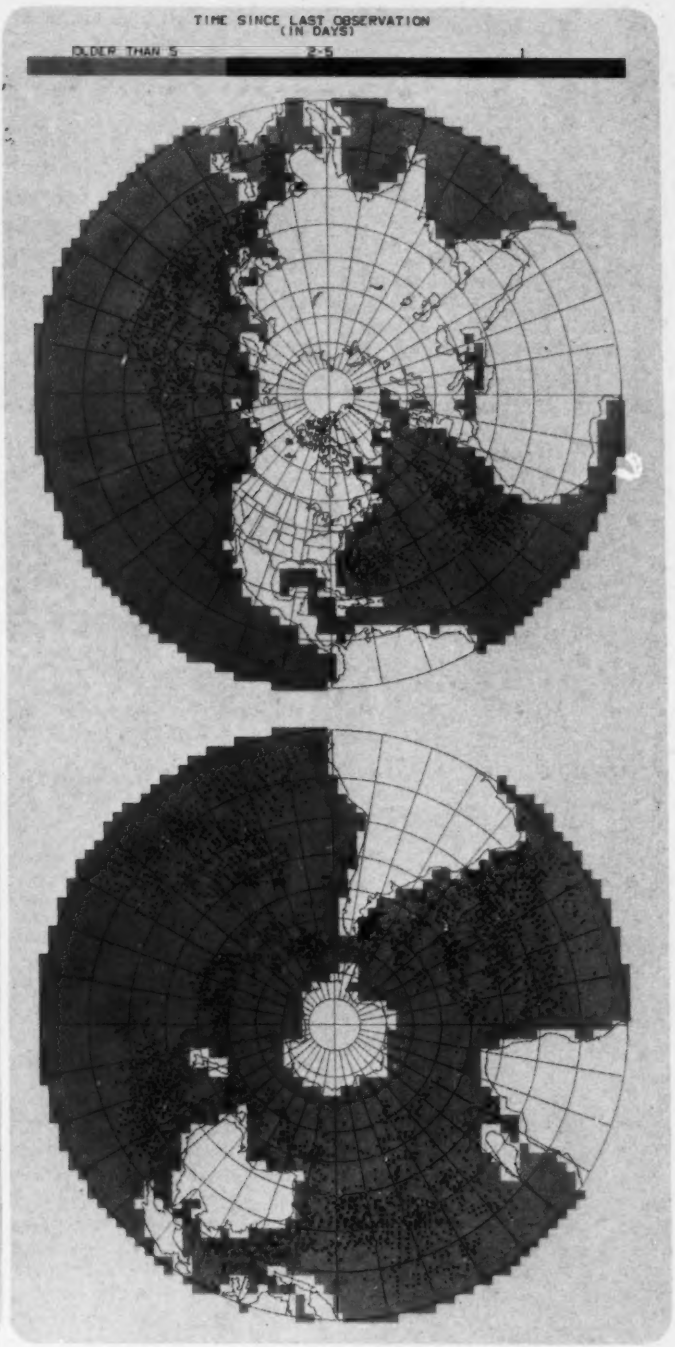
The vertical temperature profile radiometer evolved from the Satellite Infrared Spectrometers developed by the Satellite Service and successfully flown on NASA's experimental Nimbus-3 in 1969 and Nimbus-4 in 1970. The SIRS experiments were hailed as a major breakthrough in meteorology, the beginning of a new era in the application of satellites. They demonstrated that satellites can sound the atmosphere, as well as photograph its cloud systems, and can provide observational data comparable to that gathered by conventional instruments. The SIRS soundings were used operationally by the National Weather Service in analyzing weather conditions over the eastern Atlantic and most of the Pacific Ocean.

The new instrument sounds the atmosphere every half second, as the radiometer sweeps across the orbital path in a 23-step scan, covering a 32-nautical-mile square









(Far left) VHRR image shows Cape Cod, and cold continental shelf waters mixing with warmer Gulf Stream waters. (Left) The scanning radiometer system scans a 2000-nautical-mile wide swath beneath the satellite, providing data in a continuous strip. A pole-to-pole strip in the visible channel, taken November 21, showed a storm in the Bay of Bengal. (Above) Scanning radiometer data are used to produce daily global analyses of sea surface temperature.

with each step and a total area of 736 nautical miles long and 32 nautical miles wide in each scan. In this fashion, the instrument provides essentially global coverage.

With a smaller field of view than previous experimental instruments (about one-fortieth of the area covered by a SIRS sounding) and greater density of observation, the vertical temperature profile radiometer provides improved temperature soundings in regions with extensive, but not complete, cloud cover.

The instrument is designed to have an obsolute accuracy of better than 0.5 percent and, to maintain this level of accuracy, contains an internal system that calibrates the instrument frequently.

Soundings from the vertical temperature profile radiometer are acquired by the NOAA Command and Data Acquisition stations and retransmitted to National Environmental Satellite Service headquarters in Suitland, Maryland, for central analysis and processing. In addition to providing information on temperatures and water vapor in the atmosphere, the measurements are used to calculate geopotential height—the altitude of a specific pressure level in the atmosphere. The temperature soundings are used by the Weather Service's National Meteorological Center in preparing analyses and forecasts for ocean areas, and also are transmitted to other weather centers in the United States and abroad.

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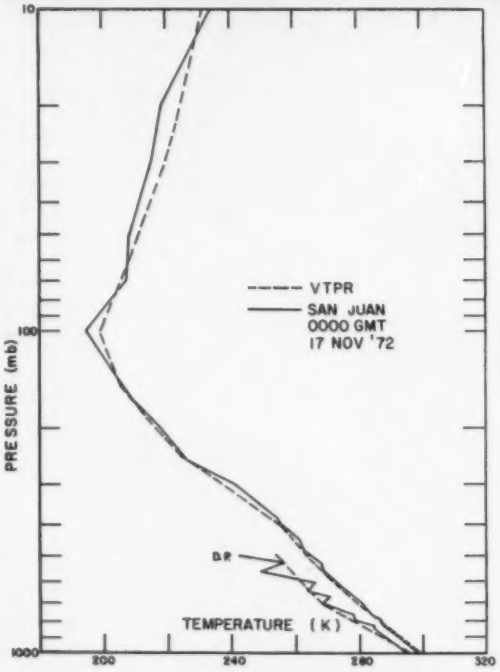
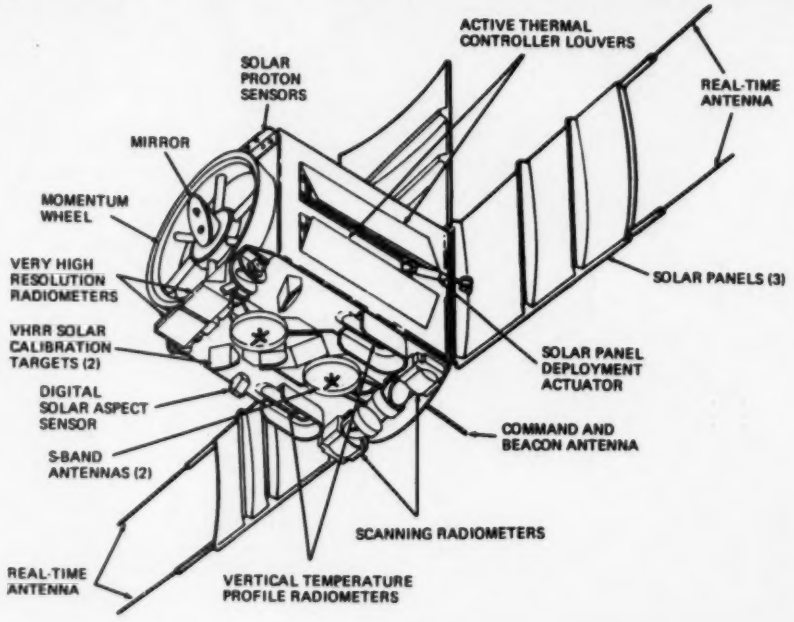




A fourth sensor on the spacecraft is the solar proton monitor which detects the arrival of energetic solar protons in the vicinity of earth. Solar proton data are acquired by the Satellite Service and transmitted to NOAA's Space Environment Laboratory at Boulder, Colorado, for use in issuing warnings of solar storms.

NOAA-2 has significantly increased the quality and quantity of satellite information available for environmental forecasting and research.

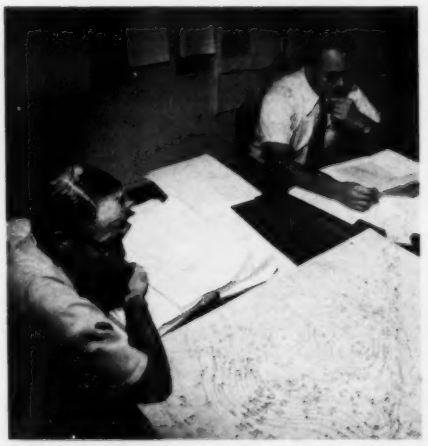
The next major milestone will be the planned October 1973 launch of NASA's Synchronous Meteorological Satellite—forerunner of NOAA's Geostationary Operational Environmental Satellite.

Like NASA's present experimental Applications Technology Satellites, SMS/GOES spacecraft will be placed in earth-synchronous orbits, from which they can continuously observe nearly half the earth. The first SMS will be "parked" at 100 degrees West over the eastern Pacific Ocean, the second over the Atlantic. After launch, these spacecraft will be operated by NOAA.

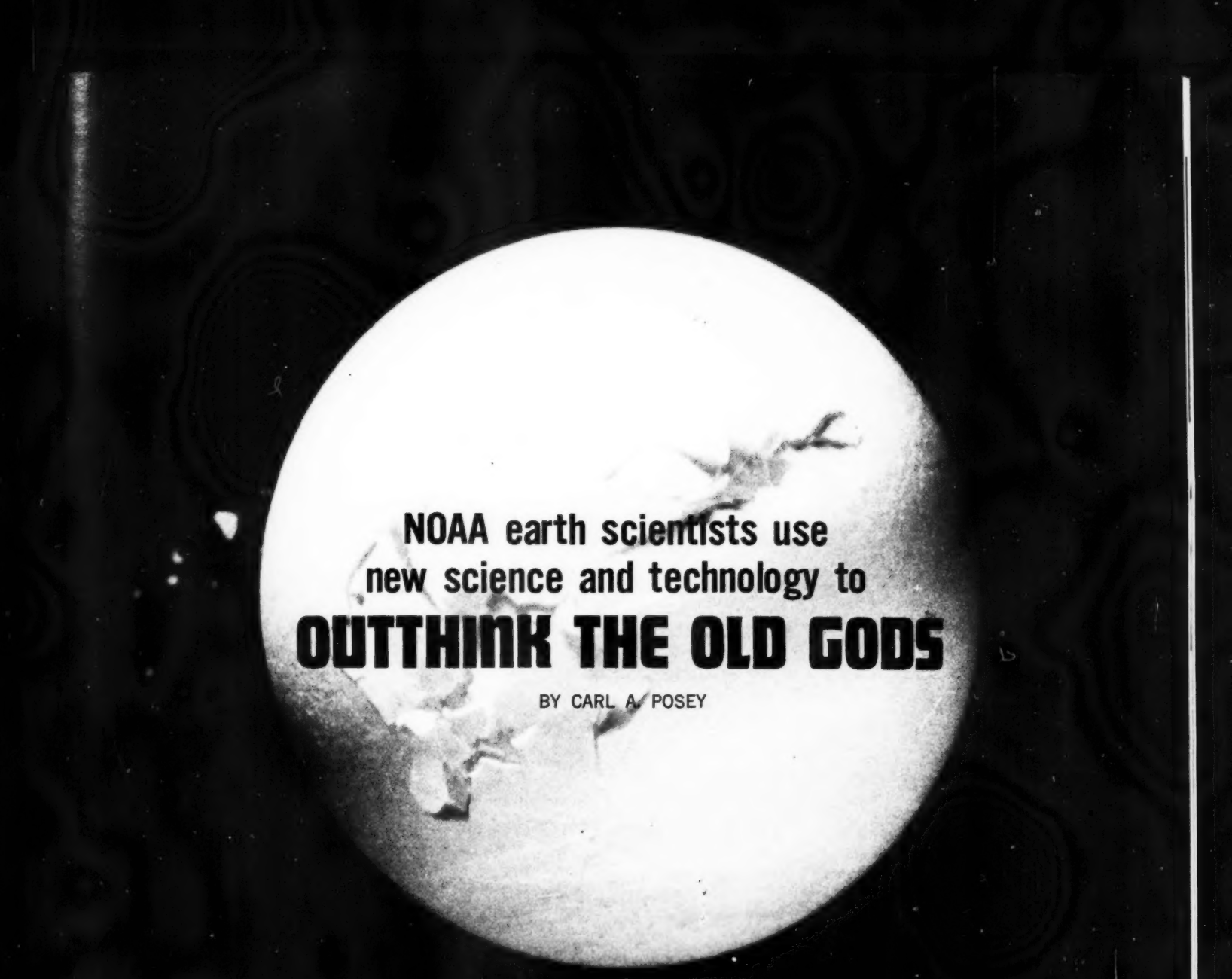
Sensors on the Synchronous Meteorological Satellite will include a visual infrared spin scan radiometer, providing visual and infrared observations of the entire earth disc every 20 minutes and a space environment monitor, measuring magnetic fields, electrons, protons, and x-ray flux. It will also collect data from remote platforms for central processing and dissemination and distribute weather maps, satellite pictures, and other data in facsimile form.

In preparation for the SMS/GOES system, the Satellite Service has established Satellite Field Services Stations at San Francisco, Kansas City, Miami, and Suitland, Md. Special antenna systems for receiving image signals from the earth-synchronous satellites already have been installed at Suitland, and are scheduled for installation at the others this summer. Each Field Services Station will be staffed with meteorologists, electronics technicians and operators, and photographers, to provide round-the-clock analysis and interpretation of the satellite data for weather, ocean, and fisheries field operations.

Together, the polar-orbiting NOAA satellites and the geostationary SMS/GOES spacecraft will form the new national operational environmental satellite system. □



(Top) Special GOES antenna systems have been installed at Suitland. (Left) Comparison of soundings made by NOAA-2's vertical temperature profile radiometer and by radiosonde. (Right) Fred Bittner, left, and Adolf Werbowetzki are members of a special group established for quality control of temperature data.



NOAA earth scientists use new science and technology to

OUTTHINK THE OLD GODS

BY CARL A. POSEY

Man's relationship to the greatest portion of his planet has been, necessarily, a small one.

Nothing we do in the way of digging, blasting, mining, tunneling, filling, building, damming, or tilling leaves more than the most superficial scratchings on the slightly out-of-round, 8,000-mile-diameter ball which carries us through the dark inhospitality of space.

And in the earth itself we have been confronted with the stuff of myth—burrowing sounds of giant moles, underground tempests, the difficult swimming on a great subterranean whale. We have always sensed the progress of time-devouring, elemental processes in the solid earth, processes revealed to us most vividly in the form of destructive earthquakes.

Faced with such forces in a land we shall probably never visit or thoroughly probe, it has been the tendency of our species to bow to the inevitable, to brace for and accept the catastrophes of this ancient enemy within. But present-day science and technology suggest alternatives to mere endurance are at hand—alternatives that derive from scientific generations of pondering the earth's internal gurgles, booms, and breaks.

This is, to an antique mind at least, an unthinkable effort to outthink the old gods. But it exists. It moves forward as persistently as the stylus of a seismograph, driven by the returns coming in from scientific inquiry and geophysical tools of the trade. In the United States, much of it is happening in the Earth Sciences Laboratories of NOAA's Environmental Research Laboratories.

The search for clues to what is happening underground began in early efforts to detect seismic activity below the threshold of human sensation—vibrations arriving from *distant* earthquakes as well as those generated by nearby ones. This work of monitoring earthquake activity has developed in the last decade into an effort with a planetary view. A worldwide network of standard seismograph instruments, installed and managed by NOAA with cooperation from participating nations, has provided the first comprehensive, mutually compatible set of global seismic data, and has done

continued

much to refine the ways in which seismologists view their subject—how they establish the "absolute" size, or magnitude, of an earthquake, how they determine the direction of fault motion associated with it, how they tally the regional and global frequencies of tremors of various depths and sizes.

In addition to the worldwide network, many cooperating agencies and institutions provide data to this global earthquake watch, and many instruments perform from vaults at NOAA's seismological and geomagnetic observatories. One of the most comprehensive of these is the observatory at Palmer, Alaska, the nerve center for a system of sensors that reaches down into southeastern Alaska and out the thin arm of the Aleutians to Adak and Shemya. At Palmer, instruments monitor earthquakes in this highly seismic corner of America with a vengeance, for earthquakes are only part of the observatory's reason for being.

The Palmer Observatory also serves as headquarters of the Alaskan Regional Tsunami Warning System, which developed out of the tsunami-devastated wreckage along Alaska's coast after the 1964 great earthquake in Prince William Sound. The goal at Palmer has been to issue tsunami warnings after potentially tsunamigenic (tsunami-generating) earthquakes in the Alaska area in the shortest time possible. The nominal lag between first detection of the earthquake and a coastwide warning is 15 minutes. Sometimes they improve on that.

Palmer's big brother in the tsunami warning business is the observatory near Honolulu, at Ewa Beach, Hawaii. This is headquarters of the Pacific Tsunami Warning System, which issues timely watches and warnings for tsunamis oceanwide, to participating nations and territories.

Perhaps the most visible portion of NOAA's earthquake-watching work is the National Earthquake Information Center, which keeps the media, general public, and disaster-relief agencies informed of significant seismic activity worldwide. In its Boulder, Colorado, location, the Center taps into seismic data circuits from instruments in California, Nevada, Utah, and Colorado; teletypewriter circuits link the Center with worldwide stations and cooperating seismological investigators. A computer terminal ties the Center to a NOAA computer in Boulder, programmed to find earthquake epicenters, depths, and other data from information input by the Center's seismologists.

While more or less conventional instruments go through their day-to-day tracing of seismic vibrations in the earth, NOAA scientists are examining some of the other aspects of this activity—fault motion, and the tiny changes in earth currents, geomagnetic field, stress and strain patterns, and the like, associated with structural adjustments in the earth. Much of this work is centered in the San Francisco-based Earthquake Mechanism Laboratory and two field facilities—Stone Canyon Observatory, south of San Francisco on the San Andreas Fault, and a network of instruments in the Aleutian Islands.

Work at Stone Canyon Observatory and at instrument sites stitched up and down across the fault by NOAA and other researchers is having some success with its unconventional look at underground processes.

Investigations of creep, a slow, non-seismic motion found along some faults, has made the several-centimeter-per-year movement of the San Andreas slightly controversial. Some scientists believe faults relieve accumulating stresses by creeping; others think creep may only occur where stresses have built up to a level beyond that which creep could successfully relieve. An interesting, recent development in this connection was the discovery of creep along the Anatolian Fault, a 500-mile-long San Andreas-like break in the earth's crust along the northern rim of Turkey. The approximate two-centimeter-per-year movement found at the crossroads village of Ismetpasha is comparable to that measured at Hollister, California, and may provide a way of comparing the similarities and differences of two large, creeping faults.

It may also mean that evolving theories can be tested against the performance of two specimen faults. For example, the proposal that fault-gouge clays, which typically go soft under stress, could cause fault creep by lubricating the fault. The presence of similar materials along creeping portions of the Anatolian Fault should permit an evaluation of this hypothesis.

Meanwhile, back at Stone Canyon Observatory, NOAA scientists continue to look at the various physical facets of seismic activity. Strainmeters—usually quartz rods installed in horizontal excavations and anchored to the ground at each end—measure the deformation of the earth caused by the accumulation and relief of subterranean stresses along the fault. Strain is a "dimensionless" quantity, expressed as units of deformation per units of length, as, for example, centimeters per centimeter; the levels typically measured here are about one part in 10 million. Tilt—changes in the local horizontal—is another physical aspect of San Andreas Fault adjustments measured by Stone Canyon instruments. And a new family of sensors is being installed to sense changes in earth currents produced by changes in ambient stress levels in underground rocks.

In a very real sense, scientists at Stone Canyon and their colleagues in other agencies and institutions are preparing a trap for some future middle-sized earthquake. The object is to measure the "near-source parameters" of a San Andreas Fault earthquake; the trap itself will represent the largest experiment of its kind ever mounted along the Fault.

Much of the work conducted at and around Stone Canyon has been repeated in the Aleutian Islands on and around Amchitka, mostly in support of Atomic Energy Commission tests there. With the last atomic test (Cannikin) completed in 1971, it appears now that NOAA will continue the Aleutian Seismic Program using the earthquake-ridden islands as a gigantic earth science laboratory for some years to come.

Continued Aleutian research should help complete the half-worked puzzle of plate tectonics—the hypothesis that the earth's crust is composed of great stony plates which are carried along by a sea floor which spreads as new material is introduced from the planet's mantle through mid-ocean rifts. Patterns of earthquake activity have been one of the keys to plate tectonics, for plate boundaries are typically marked by dense swarms and belts of earthquake hypocenters. And, conversely, plate tectonic theory has helped explain where and why some earthquakes occur. The densely instrumented Amchitka portion of the Aleutian chain has provided an unusually detailed look at the convergence of the North Pacific and Bering plates, with the oceanic plate dipping steeply under the island arc, and creating regional patterns of stress and stress relief on which an explosion the size of Cannikin —several megatons—is a mere detail.

Seismicity studies—studies of where and why earthquakes occur in the world—have begun to change dramatically in NOAA. Today's displays of seismic activity in a given region may show the usual hypocenter map superimposed on the familiar coordinates of latitude and longitude, and familiar shapes of land forms and ocean areas. But, increasingly, they are also showing depth profiles of earthquake activity, views that cut through, say, an Aleutian Island and show earthquake hypocenters concentrated within a lithospheric plate descending into the mantle. They are also being presented as a kind of geographic history, with one axis of the graph being time. In this time-space display one sees the clusters and bare areas of an area's earthquake activity.

Computer technology has made much of this possible. It is no longer necessary for a scientist to sit down and make several million dots on a map to depict global seismicity. A properly programmed computer can do that for any of a number of map

projections, in a matter of minutes. Computers are also being taught to rattle off fault plane solutions from incoming earthquake data, a capability which, once operational, should do much to tell emergency and disaster relief forces what has happened at the site of a distant earthquake soon after the earthquake has occurred.

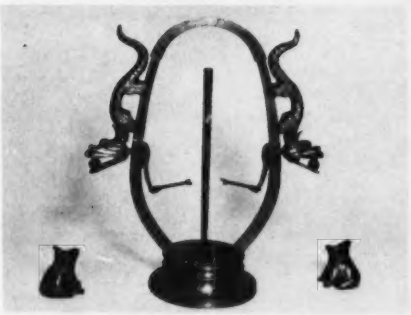
Computers are also helping structural engineers in NOAA and cooperating organizations show the vibration pattern to which a structure is subject in an earthquake. Making structures tell their stories has been the job of the strong-motion program (of NOAA's Seismological Field Survey in San Francisco) for many years. Today, the Survey manages perhaps a thousand strong-motion accelerographs—instruments that lie dormant until shaken into operation by an earthquake—located in structures in California, the Pacific northwest, Alaska, and other seismic areas of the United States. This work is expanding to provide strong-motion instruments for specific groups of structures. A recent contract from the Veterans Administration will add strong-motion instruments to some 65 VA hospitals across the country, and there is some preliminary work going on to instrument highway bridges, ramps, and other structures. The idea behind the strong-motion program is to provide the data engineers and lawmakers need to make communities more earthquake-resistant through tougher earthquake building codes, emergency procedures, and other substitutes for prophecy.

Seismologists look to earthquake prediction in the way medieval alchemists looked toward the transformation of base metals into gold: it is an objective worth pursuing but one not easily achieved. Although it may be possible to predict earthquakes from some single precursory sign or from some combination of precursors, no one believes such predictions are visible in even the middle distance of seismic research.

But NOAA scientists and their colleagues in other government and private organizations are working on promising alternatives to earthquake prediction: the prediction of earthquake effects. Investigations in the Earth Sciences Laboratories' Seismological Research Group are following several avenues toward establishing more precise ways of identifying seismic risk. The concept of seismic risk can be regional, but more often it is a highly localized kind of value, and an elusive one. For example, where does serious risk begin? With the single-family nightmare of a house in which all the plaster has been cracked or the collective one of a neighborhood mostly destroyed? The research aims at answering such questions, principally by learning from earthquakes of the recent past, especially the instructive catastrophe at San Fernando in February 1971.

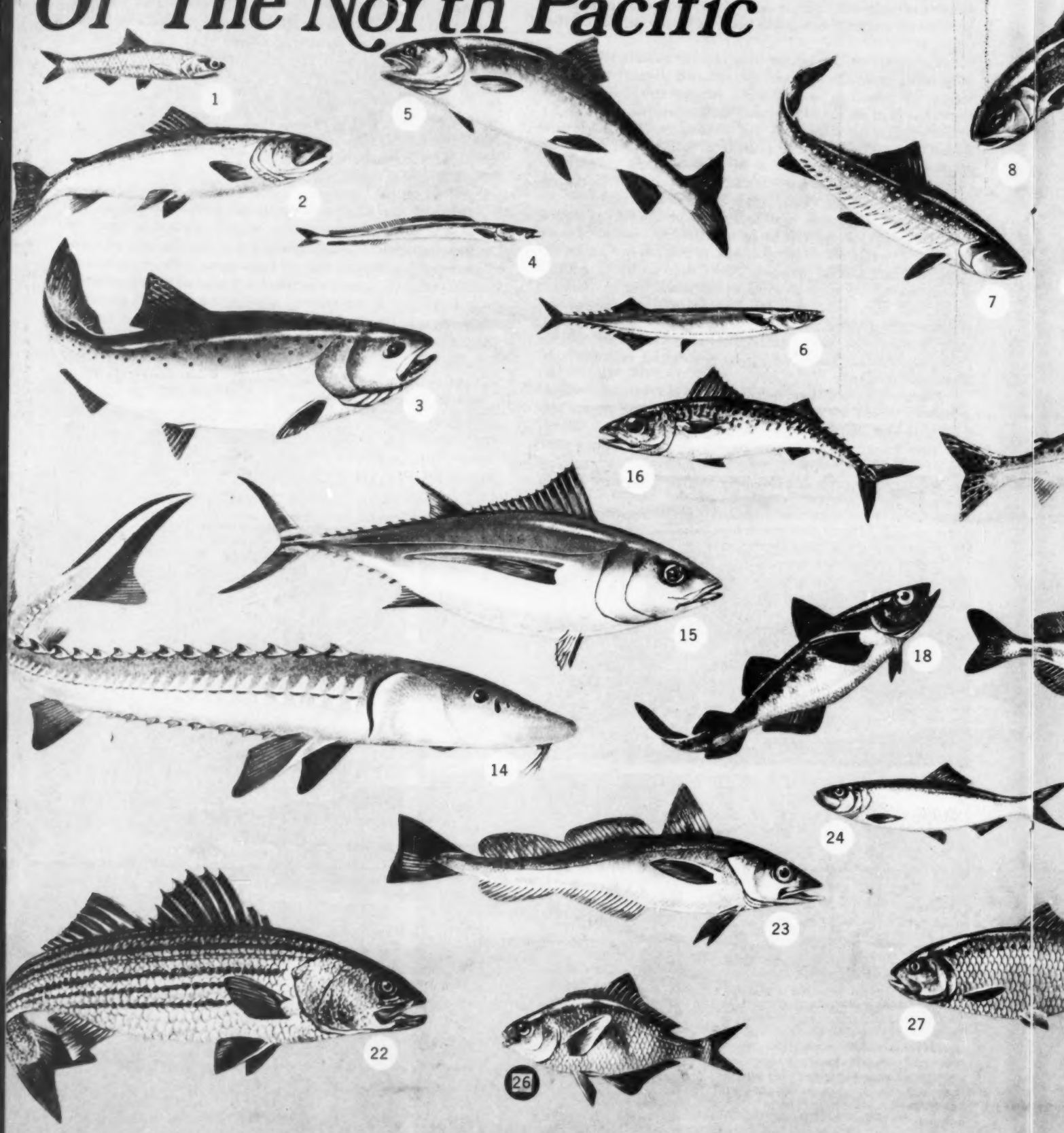
What of municipal vital functions? Under contract to the Office of Emergency Preparedness, NOAA prepared a report on the possible effects on San Francisco Bay area people and cities of earthquakes of several different magnitudes, occurring in several different locations. Such "scenarios" are part of OEP's effort to *preplan* the disaster relief a city will need when and if a seismic disaster strikes, and it is probable that such studies will be developed for other major urban centers in areas of high seismic risk.

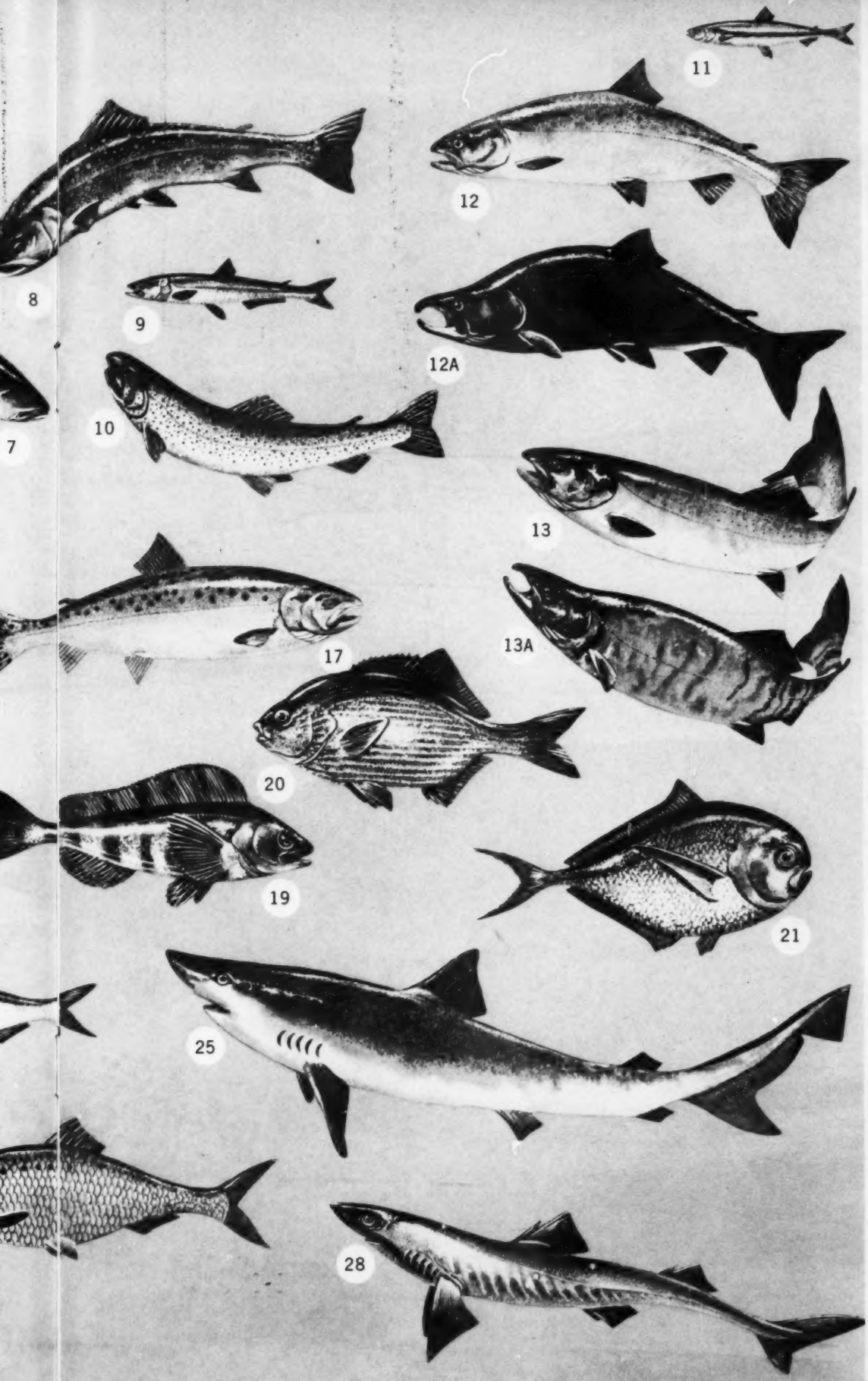
It is a beginning, then, as are the families of seismic risk maps being issued by these researchers—maps that focus down from a continental scale of earthquake hazard to a regional one. At some point, this work of assessing seismic hazard, development of new sensors and instrumental techniques, and the day-to-day monitoring of a planet's internal tickings will come together to provide the crucial answers man must have to face down this ancient enemy. □



(Top) Earthquake damage. (Far right) San Andreas fault trace crosses field. (Right) Recording seismic vibrations. (Above) In this second-century Chinese seismoscope, earth vibrations knocked a metal ball from a dragon's jaws into the mouth of a frog, giving a rough indication of the direction of earth movement. Smithsonian photograph.

Marine Fishes Of The North Pacific





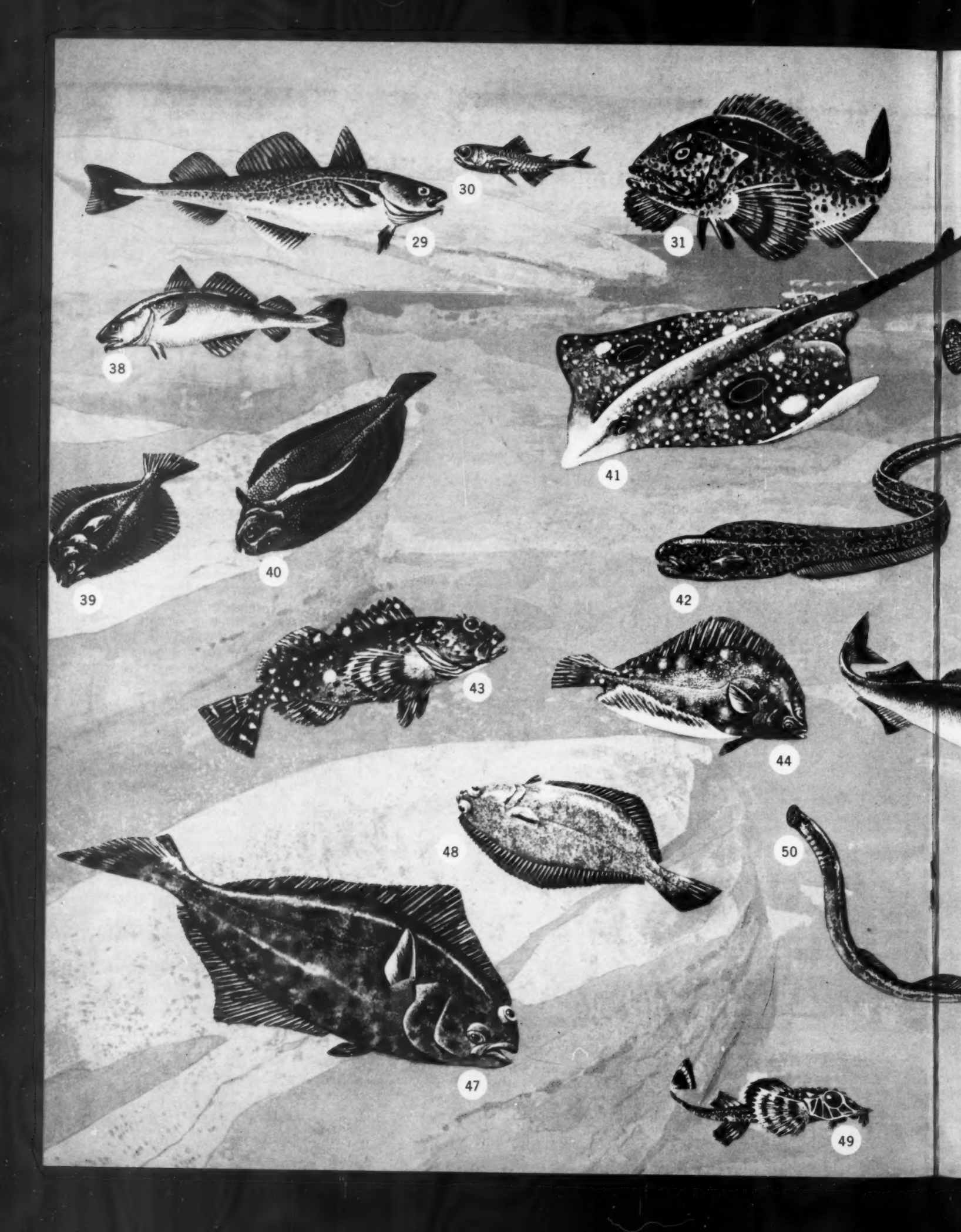
1. Northern anchovy
   Engraulis mordax
2. Steelhead trout
   Salmo gairdneri
3. Chinook salmon
   Oncorhynchus tshawytscha
4. Pacific sand lance
   Ammodytes hexapterus
5. Coho salmon
   Oncorhynchus kisutch
6. Pacific saury
   Cololabis saira
7. Dolly Varden (sea-run)
   Salvelinus malma
8. Arctic char (sea-run)
   Salvelinus alpinus
9. Eulachon
   Thaleichthys pacificus
10. Cutthroat trout (sea-run)
    Salmo clarki
11. Surf smelt
    Hypomesus pretiosus
12. Sockeye salmon
    Oncorhynchus nerka

12A. Sockeye salmon
    (Spawning male)

13. Chum salmon
    Oncorhynchus keta

13A. Chum salmon
    (Spawning male)

14. White sturgeon
    Acipenser transmontanus
15. Albacore
    Thunnus alalunga
16. Chub (Pacific) mackerel
    Scomber japonicus
17. Pink salmon
    Oncorhynchus gorbuscha
18. Walleye pollock
    Theragra chalcogramma
19. Atka mackerel
    Pleurogrammus monopterygius
20. Striped seaperch
    Embiotoca lateralis
21. Pacific pomfret
    Brama japonica
22. Striped bass
    Morone saxatilis
23. Pacific hake
    Merluccius productus
24. Pacific herring
    Clupea harengus pallasi
25. Soupfin shark
    Galeorhinus zyopterus
26. Pile perch
    Rhacochilus vacca
27. American shad
    Alosa sapidissima
28. Spiny dogfish
    Squalus acanthias
29. Pacific cod
    Gadus macrocephalus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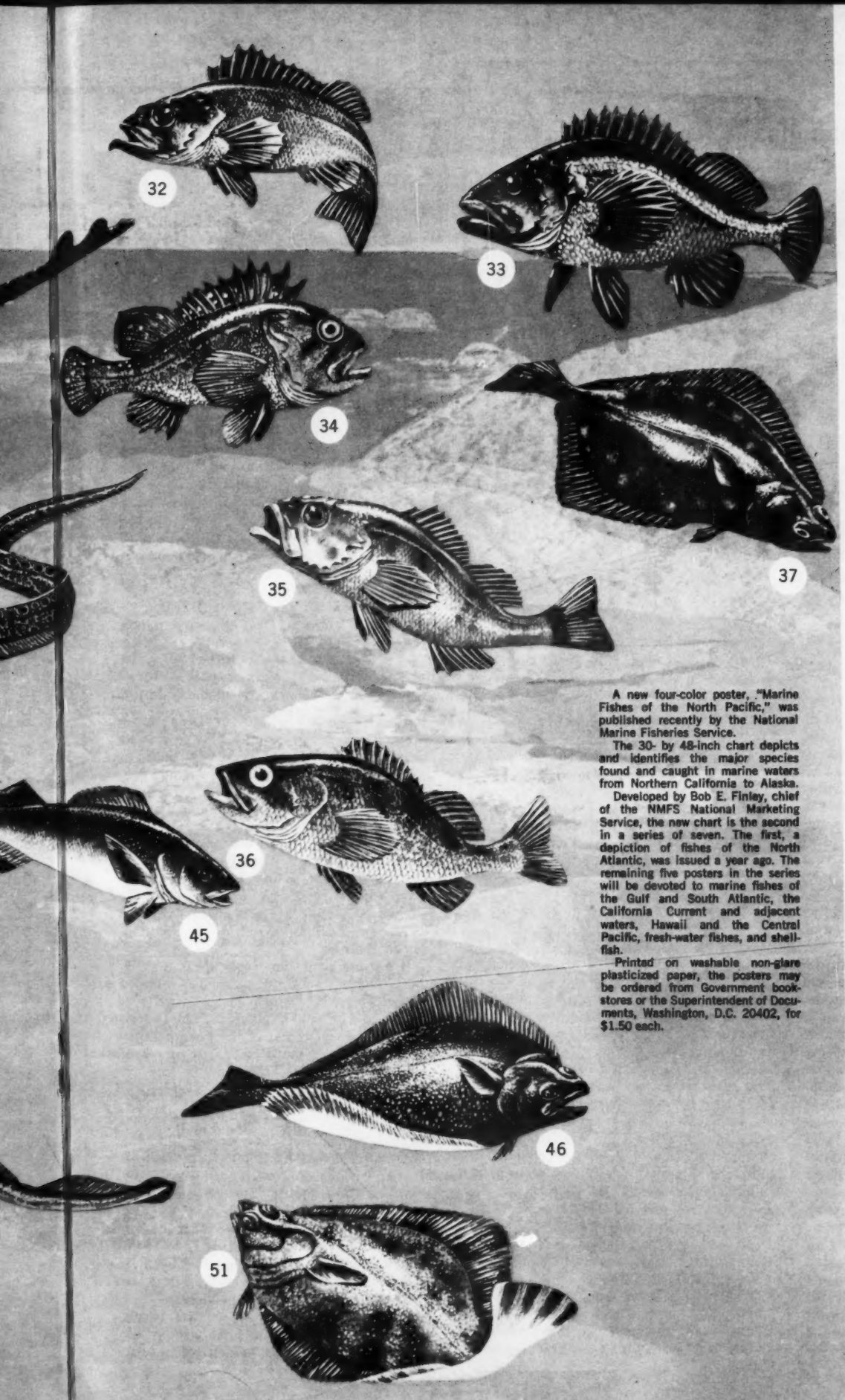


A new four-color poster, "Marine Fishes of the North Pacific," was published recently by the National Marine Fisheries Service.

The 30- by 48-inch chart depicts and identifies the major species found and caught in marine waters from Northern California to Alaska.

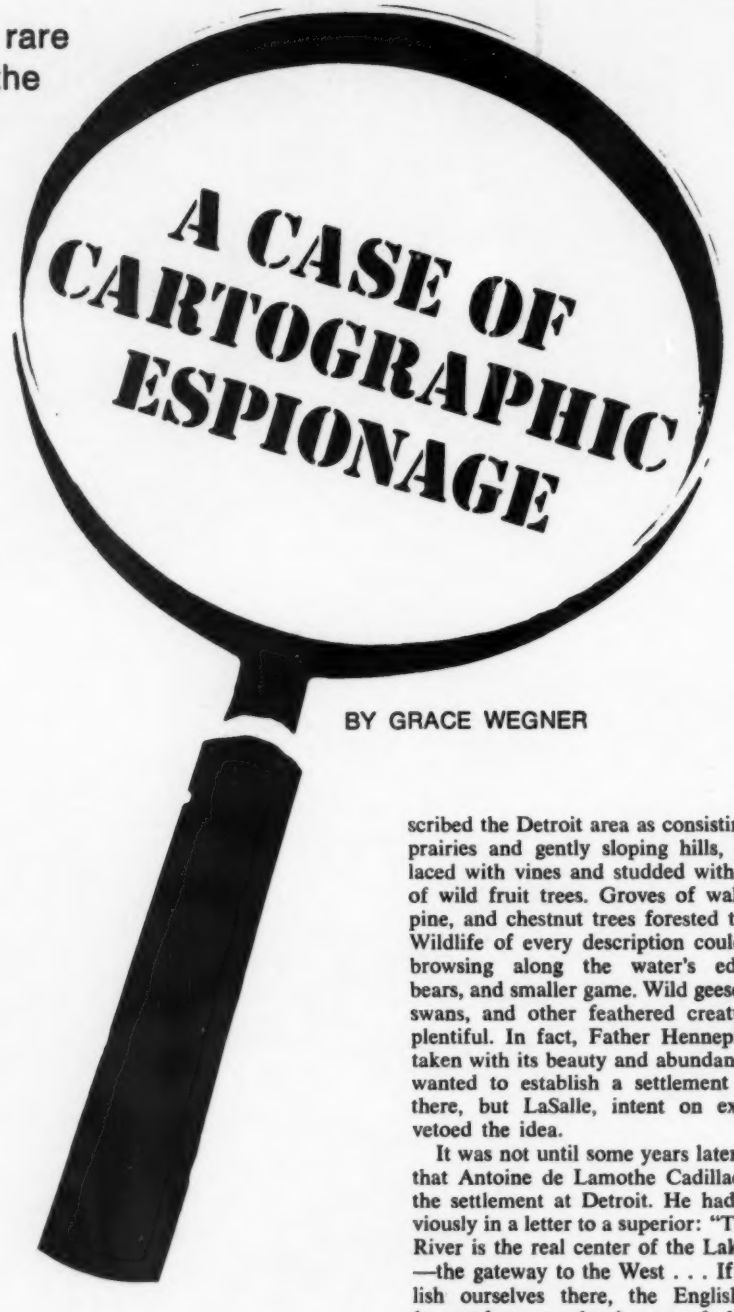
Developed by Bob E. Finley, chief of the NMFS National Marketing Service, the new chart is the second in a series of seven. The first, a depiction of fishes of the North Atlantic, was issued a year ago. The remaining five posters in the series will be devoted to marine fishes of the Gulf and South Atlantic, the California Current and adjacent waters, Hawaii and the Central Pacific, fresh-water fishes, and shellfish.

Printed on washable non-glare plasticized paper, the posters may be ordered from Government bookstores or the Superintendent of Documents, Washington, D.C. 20402, for $1.50 each.

29. Pacific cod
Gadus macrocephalus
30. Bigfin lanternfish
Myctophum californiense
31. Lingcod
Ophiodon elongatus
32. Pacific ocean perch
Sebastes alutus
33. Yelloweye rockfish
Sebastes ruberrimus
34. China rockfish
Sebastes nebulosus
35. Rougheye rockfish
Sebastes aleutianus
36. Black rockfish
Sebastes melanops
37. Petrale sole
Eopsetta jordani
38. Pacific tomcod
Microgadus proximus
39. English sole
Parophrys vetulus
40. Rex sole
Glyptocephalus zachirus
41. Big skate
Raja binoculata
42. Wolf-eel
Anarrhichthys ocellatus
43. Cabezon
Scorpaenichthys marmoratus
44. Rock sole
Lepidopsetta bilineata
45. Sablefish
Anoplopoma fimbria
46. Arrowtooth flounder
Atheresthes stomias
47. Pacific halibut
Hippoglossus stenolepis
48. Dover sole
Microstomus pacificus
49. Sturgeon poacher
Agonus acipenserinus
50. Pacific lamprey
Entosphenus tridentatus
51. Starry flounder
Platichthys stellatus

Lake Survey Center has a rare copy of an early chart of the Detroit River, prepared in secret by the French

A CASE OF CARTOGRAPHIC ESPIONAGE



BY GRACE WEGNER

THE SMALL BATEAU slipped almost silently out into the dark, gently rippling waters of the Detroit River. Only the gentle slap of wave against wooden hull could be heard as it drifted downstream. The midnight hush was broken now and then by the quiet drip of water from a carefully raised oar as its occupants paddled slowly and methodically back and forth across the gloomy river. A man whispered occasionally to another.

The year was 1796, and the boatmen were French loyalists from the little town of Detroit, recently surrendered by the British to the young American Republic under the terms of the Jay Treaty. Their mission was to gather data secretly for use in charting the area.

In their search for furs, early Frenchmen had pushed westward, establishing trading posts around the Great Lakes and up and down the Ohio and Mississippi Rivers. Detroit was one of them. Detroit is French for "strait," and it was so named by its discoverer, Robert Cavalier Sieur de La Salle (commonly called LaSalle for his ancestral estate in France), when he sighted it on August 11, 1679. Even in those early days, LaSalle predicted that this area connecting Lakes Huron and Erie would one day be of extreme importance. His prediction has since been fulfilled, the Detroit of today being one of the largest and busiest ports on the Lakes.

Father Louis Hennepin, a Recollect priest and intimate friend who accompanied the great explorer on this historic occasion, described the Detroit area as consisting of vast prairies and gently sloping hills, the latter laced with vines and studded with orchards of wild fruit trees. Groves of walnut, oak, pine, and chestnut trees forested the banks. Wildlife of every description could be seen browsing along the water's edge—deer, bears, and smaller game. Wild geese, turkeys, swans, and other feathered creatures were plentiful. In fact, Father Hennepin was so taken with its beauty and abundance that he wanted to establish a settlement then and there, but LaSalle, intent on exploration, vetoed the idea.

It was not until some years later, in 1701, that Antoine de Lamothe Cadillac founded the settlement at Detroit. He had said previously in a letter to a superior: "The Detroit River is the real center of the Lake country —the gateway to the West . . . If we establish ourselves there, the English can no longer hope to deprive us of the benefits of the fur trade."

Most French settlements were primarily trading posts, but the forward-looking Cadillac had other plans for his settlement. He had visions of Detroit being not only a trading post, but a city complete with churches, schools, hospitals, and growing families as well. To fulfill his dream, when he landed at Detroit on July 24, 1701, Cadillac had with him one hundred Frenchmen, both soldiers and artisans, and an equal number of friendly Algonquin Indians. They began building at once. Their first efforts consisted of a church and small shelters for themselves. The Indians settled around the

new outpost, which was called Fort Pontchartrain. By 1703, the little post was well on its way, even Madame Cadillac and Madame Tonty (the wife of Cadillac's lieutenant) having joined their husbands in the fledgling city.

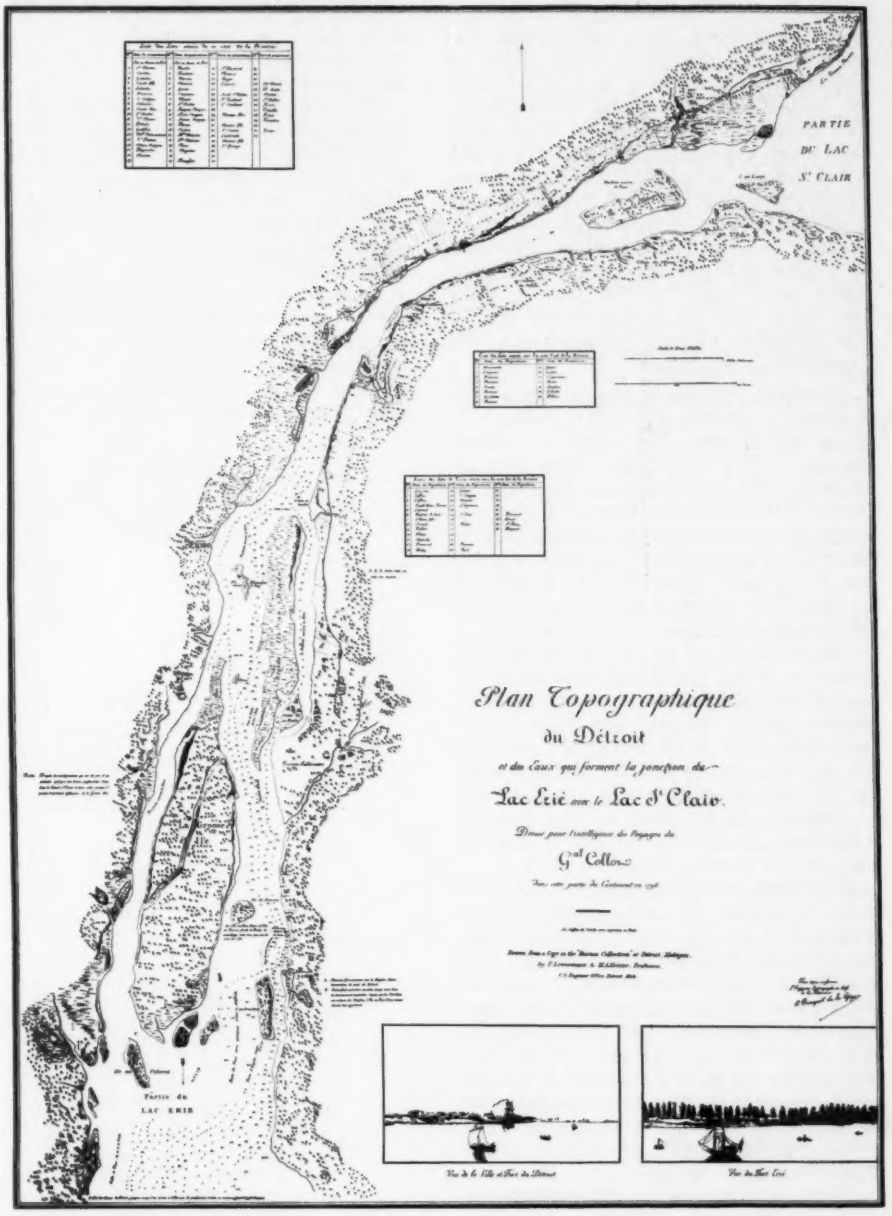
The young settlement, however, was destined to change hands four times, under three flags—French, British, and American, before it finally settled down to becoming the bustling metropolis it is today. In 1760, it passed from French to English hands. Later, when a new fort was built, the name was changed to Fort Lernoult and still later to Fort Shelby. The Federal Building today stands on part of this site. On July 11, 1796, Captain Moses Porter and 45 American soldiers raised the first stars and stripes to fly over the city. When the War of 1812 broke out, one of the blackest moments in its history took place when the American commander, General William Hull, surrendered the city to the British without firing a single shot. However, after the Battle of Lake Erie was won by Commodore Oliver Hazard Perry on September 10, 1813; the little town was evacuated and once more turned over to the United States.

It was during the early period, when the town was first in the possession of the young Republic, that the French loyalists were commissioned to help General Collot gather data to complete a chart of the Detroit River for possible use in case war should break out once again. The material they accumulated in secrecy was later compiled by General Collot and resulted in a remarkably accurate picture of the area. The original of this chart hangs today in the French Marine Department in Paris, and copies—of which there are very few in existence—can be found in the Burton Historical Museum in Detroit and on the wall of the Lake Survey Center's chart sales room.

George Henry Victor Collot was born in Chalon-Sur-Marne, France, in 1751 or 1752. He served under Napoleon Bonaparte and was detailed on March 1, 1780, to act as Aid-Marechal General des Logis in the Auxiliary Army and sent with it to Rhode Island. His duties and exploits in the following years took him throughout the colonies and on May 27, 1792, after having been promoted to Marechal de Camp on December 1791, he was appointed Governor of Guadeloupe, an office he held until its capture by the British in 1794, when he was made a prisoner of war. He was paroled in 1796, and came to the United States on tour. It was from this tour that the map resulted.

General Collot and two other men were chosen by Auguste Adet, Minister of the French Republic to the United States, ostensibly to tour the western territories of that country, but in reality to spy on and ascertain the feelings of the local populace, including the Indians. They were also to encourage the colonists to secede from the union and form a separate connection with some foreign power—preferably France.

Collot was well qualified to carry out this undercover mission. He was a loyal



A copy of Collot's map of Detroit.

Frenchman with dreams of reconquering some of the territory for his beloved France. He stood over six feet tall and had a robust physique. He was in perfect health and well able to undertake the rigors of a long and arduous journey. He was a linguist as well, and could converse with the American frontiersman in his own language, speaking, reading, and writing English like a native. In addition, he was a professional military man and a specialist in topographic studies. As the former, his knowledge of the art of fortification enabled him to analyze expertly the strengths and weaknesses of any fortified area he might be called on to reconnoiter. He was a good cartographer and somewhat of an artist, as witnessed in the various sketches he made of the forts and block-houses he visited.

Adet made no secret of the General's intended trip. In fact, he notified both the American and Spanish governments that Collot planned to journey along the Ohio and Mississippi Rivers and their tributaries. He omitted mentioning the intended military, political, and economic reconnaissance. Permission was granted for the tour, but suspicious officials of the two countries decided to keep an eye on him.

The early part of General Collot's travels took him from Philadelphia to McKeesport, Pennsylvania, on the Monongahela River not far from Pittsburgh where he landed on March 21, 1796. He had made sketches of the towns, forts, terrain, and possible military sites all along the way. Leaving Pittsburgh, he continued west and south, making copious notes of anything that might prove of military value—land features, rate of flow of rivers, soil, and even the agricultural products. He carried the best maps then available, and added to and corrected them

continued

as he went along. As a cartographer, his notes showed changes in the course of channels, depth of rivers, and the locations of islands, sand bars, and promontories. His notebooks were filled to overflowing with observations and comments on any and every subject he believed might prove useful in preparing his final report for his superiors in Paris—a report he hoped would be used at some time to regain possession of Louisiana. If that happened, France once again could take over the frontier states and territories. This, at least, would deprive the Americans of their domain west of the Appalachian Mountains.

General Collot never actually made it to Detroit, according to Judge James V. Campbell, a noted local historian during the late 1800's. The Detroit Free Press of May 4, 1890, quoted Judge Campbell as saying, "The coming of General Collot was known to our government, as fully appears from secretary McHenry's letter to Governor St. Clair, and the object of his visit was so distasteful to the class of loyal citizens of Detroit, that it was quite likely harm might befall him if he should undertake to enter the town." The Judge went on to tell how Collot had been warned of this bitter feeling against him and decided it best to retrace his steps south. Hence the need for his stealthy confederates to carry out their furtive work of collecting the needed data.

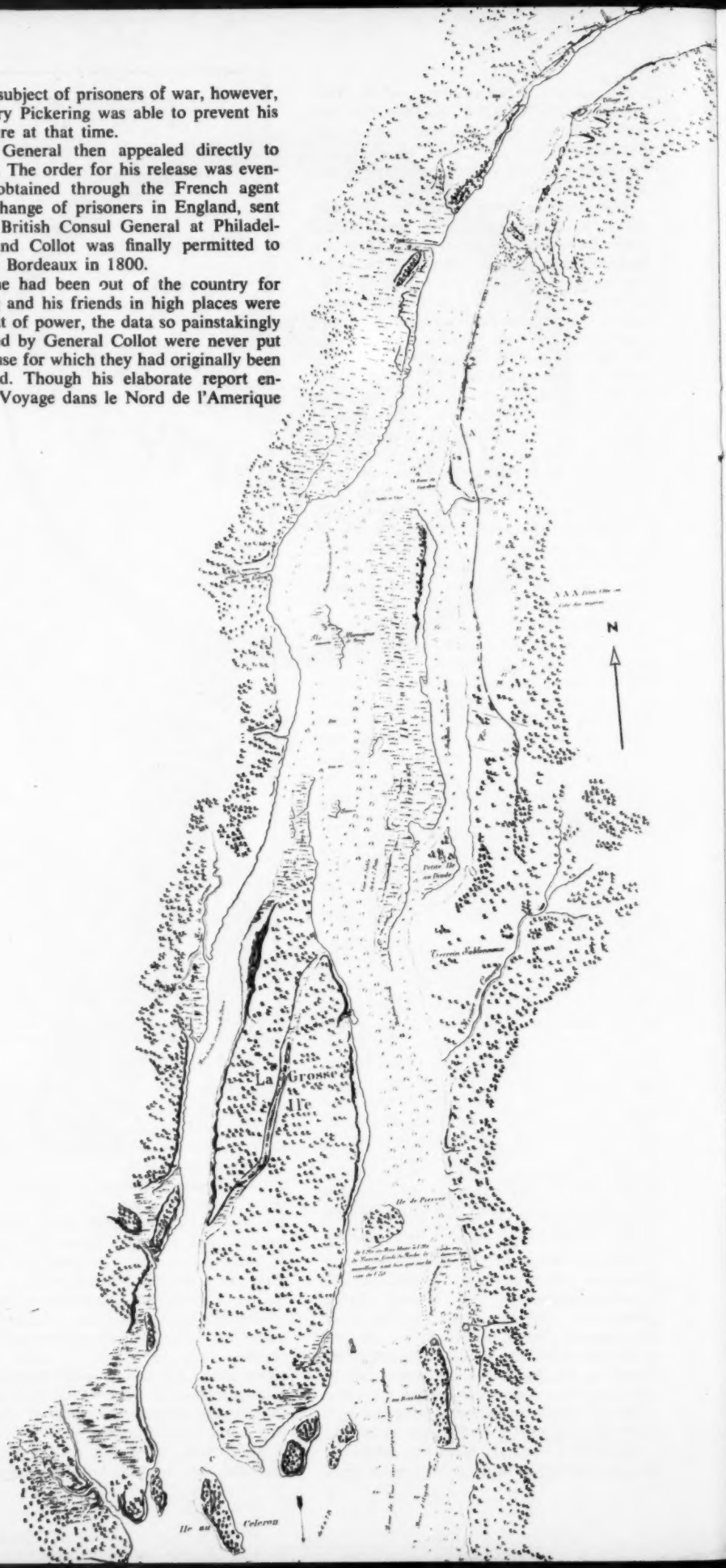
Returning as far south as New Orleans, Collot was captured by the Spanish authorities and his papers taken from him.

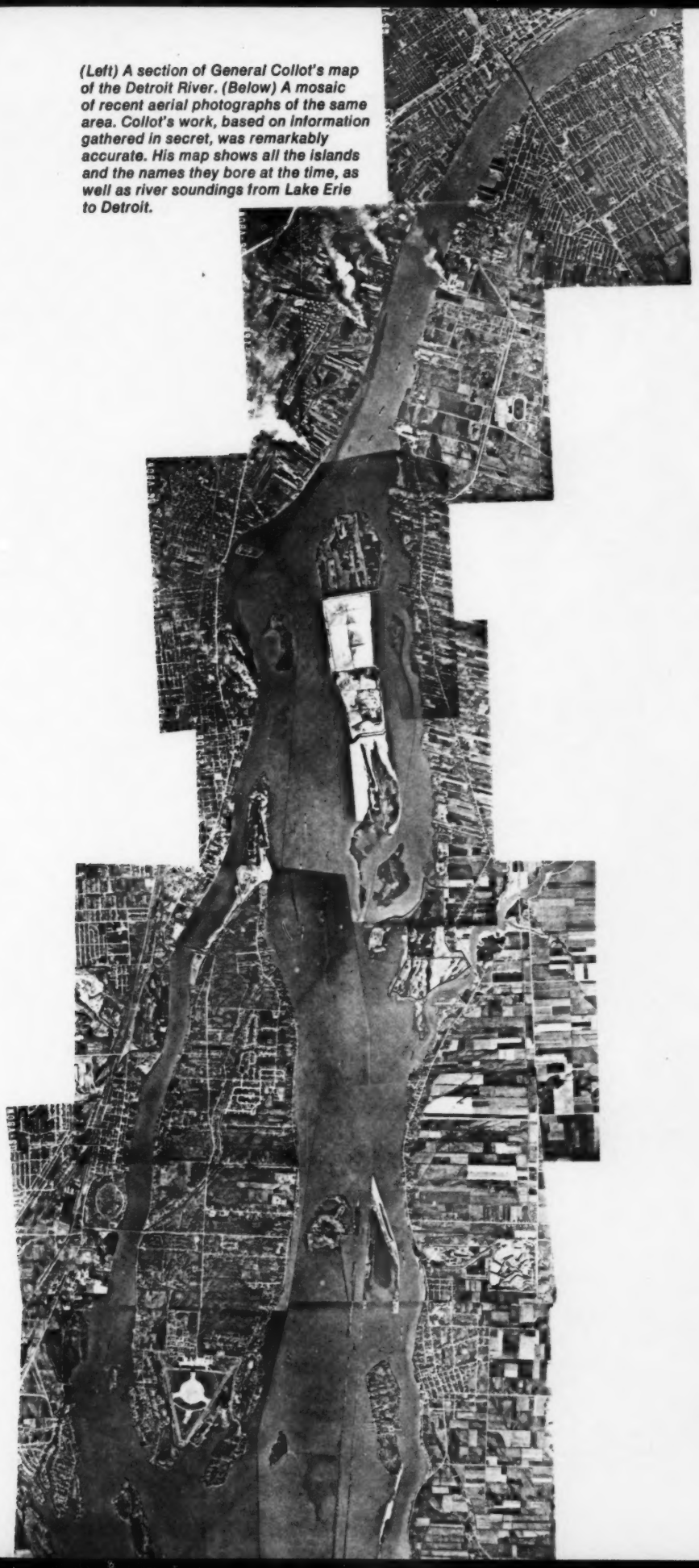
The newspaper quote continues: "He must have anticipated the capture and prepared for it. The genuine report of his travels, he forwarded by other hands than his own to France, and then prepared a fictitious report, abounding in praises of the Spanish Governor, the government and the people. The Spaniards were so well pleased with the report, which they supposed Collot intended to make to his government, that they permitted him to have more privileges than were consistent with his station as a prisoner, and he escaped."

When John Adams became President in 1797, he also was concerned about the presence of Collot in America. He feared that the extensive knowledge and the topographic surveys and intelligence data Collot had surreptitiously acquired throughout Spanish Louisiana and the Ohio and Mississippi River valleys could well be indispensable to the French if Louisiana were transferred from Spanish to French sovereignty. The President was thinking of having him deported, but Timothy Pickering, then Secretary of State, advised against this. He reasoned that if Collot could go in person to France he might be able to persuade his superiors to acquire and garrison Louisiana. It would be better, therefore, to have him where they could keep track of his activities. The President agreed, and Pickering enlisted the help of the British Ambassador in detaining him. In 1798, General Collot made known his desire to return to France. Because of a temporary break in the friendly relations between Great Britain and France on the subject of prisoners of war, however, Secretary Pickering was able to prevent his departure at that time.

The General then appealed directly to France. The order for his release was eventually obtained through the French agent for exchange of prisoners in England, sent to the British Consul General at Philadelphia, and Collot was finally permitted to sail for Bordeaux in 1800.

As he had been out of the country for so long and his friends in high places were now out of power, the data so painstakingly garnered by General Collot were never put to the use for which they had originally been intended. Though his elaborate report entitled "Voyage dans le Nord de l'Amerique





(Left) A section of General Collot's map of the Detroit River. (Below) A mosaic of recent aerial photographs of the same area. Collot's work, based on information gathered in secret, was remarkably accurate. His map shows all the islands and the names they bore at the time, as well as river soundings from Lake Erie to Detroit.

en 1796" was probably prepared and printed before his death in 1805, it was a number of years before the information was actually used, and then primarily as a source for historians.

The fact that much of the information for the Detroit map was gathered by stealth, or completed from numerous smaller sketches forwarded from time to time to Paris by French subjects in Detroit, emphasizes the excellence of Collot's work. The map contains the entire outline of the Detroit River, including the two forts, one at the upper end of Bois Blanc Island and the other on the opposite Canadian shore, as well as all the islands and the names they bore at that time. It shows the soundings of the river from Lake Erie to Detroit, and the French farms on both sides of the river, with the names of their owners—information of significant historical value.

In the 1880's, a man with an insatiable passion for anything related to Detroit and its history learned of the existence of the Collot map hanging in Paris. The man was Clarence M. Burton, one-time President of the Detroit Historical Society, author of numerous books and papers on Detroit history, founder of the Burton Historical Collection, and for a short time in his early career an employee of Lake Survey. Mr. Burton was determined to obtain a copy for his collection. His efforts led to negotiations with members of the Archives of the Department of Marine in Paris and involved Senator James McMillan, the U.S. Ambassador to France, the Minister of Marine, and numerous others. To speed things up, the Honorable Whitelaw Reid, then Ambassador, paid the necessary 300 francs to have it copied. Early in 1890, it finally became a prized addition to Mr. Burton's collection.

How Lake Survey Center came into possession of its copy is a mystery. No records can be found as to when or why it was obtained, nor can any "old-timers" remember anything other than that "it has always been there." Perhaps, remembering his early days at Lake Survey, Mr. Burton himself offered to provide it; or maybe some enterprising surveyman or District Engineer visited the Burton Museum and, noting the map's significance and relationship to Lake Survey's work, arranged for a copy. All of this, however, is pure conjecture. At any rate, a copy of the historic old chart bearing the undated notation, "Drawn from a Copy in the 'Burton Collection' at Detroit, Michigan by F. Leesemann & M. A. Heinze, Draftsmen, U.S. Engineer Office, Detroit, Mich." and containing a short comment by Mr. Burton, does hang in Lake Survey Center's chart sales office. Though much smaller than the 51-by-71-inch original, it nevertheless has all the charm and detail of the master copy. This copy, too, has been enhanced in watercolor by some long-gone unknown artist.

So, while we may never know just how or why it got there, this bit of history—the result of General Collot's early espionage activities continues to be a conversation piece at the Lake Survey Center. □

Texas A&M researchers, supported by the Sea Grant Program, started a mariculture project in the state's marshlands.

TEN ACRES OF SHRIMP

BY LEATHA F. MILOY*

The Texas coast does not meet the sea dramatically. Beginning about 50 miles inland, the grasslands and rolling hills of the coastal plains slope gradually to the sea, merging with the warm waters of the Gulf of Mexico. Three hundred thousand acres of lowlands and marshes form a coastal apron draped across the doorstep of the nation.

It is a region rich in natural resources. The low hills and mounds are salt deposits which began building 230 million years ago, gradually intruding upon overlying rock and soil to create salt domes. Crevices and pockets formed by the upward movement of the buoyant salt serve as natural traps for petroleum, and the landscape is dotted with drilling rigs and production units. Traces of sulphur operations are evident, displaying bright splashes of yellow as strong contrasts to the dull green vegetation and dusty soil. Next-door neighbors to the oil field are the fertile bays and estuaries of the Gulf Coast, nursery grounds for a major portion of the nation's shrimp catch.

Recently Texas A&M University researchers supported by NOAA's Sea Grant Program began developing another use for this coastal marshland. For four years, a shrimp mariculture team from the University's Texas Agricultural Extension Service has been creating a new industry for Texas—shrimp farming. And at the end of the fourth year of pond work, they believe they're very close to proving the commercial feasibility of farming for shrimp.

A record yield of white shrimp—1,800 pounds per acre—was harvested from the University's ponds in Brazoria County, 40 miles southwest of Houston, in the fall of 1972. The crop was worth almost $1,400 per acre. The shrimp tails, which are the edible portion, weighed in at 1,200 pounds and measured 48 to the pound.

"This crop is strong support for the feasibility of commercial shrimp production," Dr. Jack C. Parker, Sea Grant Mariculture Program Coordinator, reports. "It should be posible to harvest a ton of shrimp per acre in 90 to 120 days during the growing season (early April through late October), and we can expect three to five crops per year with proper engineering of our production units."

Assuming a minimum of three crops a year, production of 1,800 pounds of shrimp valued at approximately $1.12 per pound (tails only) could provide a gross income of $4,700 per acre each year. Not bad for land which has traditionally been put to little use other than marginal pasture land.

The 1972 harvest is almost 2.5 times greater than the previous yields. In 1971 and early 1972, the highest yields had been between 700 and 800 pounds per acre. Two factors are cited for the improved production. One is the availability of large quantities of native and non-native white shrimp from the hatcheries, and the other is a new water circulating system.

"The improved circulation system has been our greatest break-through," Hoyt Holcomb, mariculture specialist and on-site project leader, explains. The 20 half-acre ponds utilize a gravity-flow water circulation system, a modified form of the raceway system, which allows waste ammonia and hydrogen sulfide that may inhibit growth of the shrimp to be eliminated. Water is pumped into a reservoir between two rows of ponds and is held at a higher level than the five-foot water level in the shrimp ponds. When new water is needed to flush out the ponds, an elbow pipe is turned down at the reservoir end of the pond, permitting water to flow in from the holding tank. At the other end of the pond a takeout pipe at surface level drains water out.

Another significant improvement is the

continued

** Leatha Miloy is head of Texas A&M University's Department of Marine Resources Information, and Assistant to the Vice President for Academic Affairs for publications.*

use of a new special diet for shrimp prepared by a commercial firm. A flaky protein ration resembling breakfast cereal, the feed remains intact and appetizing to the shrimp for as long as 24 hours before dissolving. The diet used in the 1972 experiments was a 25 percent protein formula which resulted in approximately the same growth rates achieved in earlier tests with 35-40 percent protein formulas. The conversion ratio now stands at about two pounds of feed needed to produce one pound of shrimp.

The ponds are fertilized with inorganic nitrogen to encourage growth of natural organisms upon which the shrimp also feed.

At the end of each pond. flood gates called "harvest flumes" are built to drain the ponds at harvest time. A net is placed at the end of the drainage pipe to trap the shrimp as they are carried out with the escaping water, providing for the harvest of 99 percent of the crop.

Work on the shrimp mariculture program began in 1969. With the help of the Brazoria County Mosquito Control District, which has remained a partner in the shrimp work, a team from the Texas Agricultural Extension Service secured bulldozers to build up levees for five-foot-deep reservoir-type ponds in the marsh. Ten half-acre ponds were constructed during the first year and ten others were added in 1971.

The topsoil of the area, sand and silt deposited by the Brazos and Colorado River systems, is underlain with the tougher, more compressible Beaumont clay of the Pleistocene period. The clay prevents seepage of the water, making possible the low-cost bulldozed ponds.

Salt water is pumped from nearby Chocolate Bayou to fill the ponds. They are then stocked with postlarval shrimp at a rate of 50,000 to 65,000 per acre. About two-thirds of these survive to market size.

After the ponds are stocked, 80 to 120 days are required to produce a marketable crop. During that time, the shrimp grow to 13.5 grams, between four and six inches in length, producing about 30 to 35 shrimp per pound, head on.

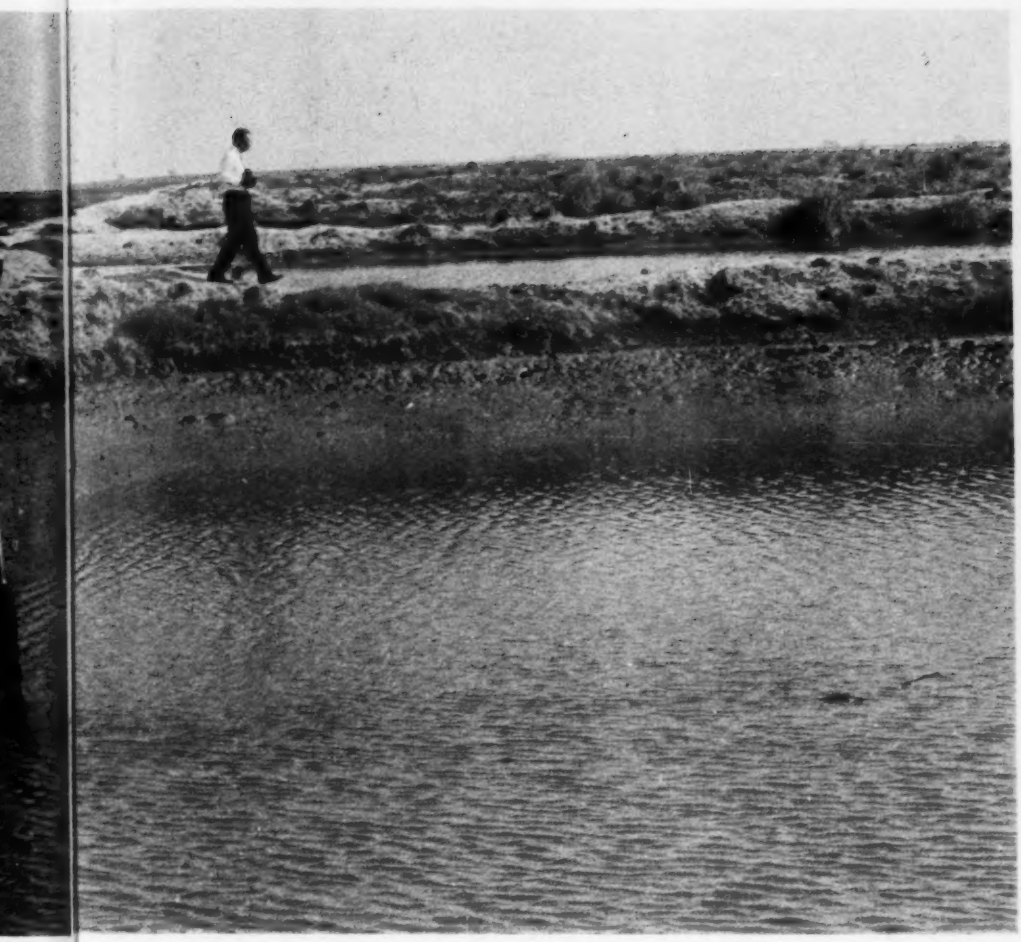
Although the outlook for production of edible shrimp is good, the earliest commercial use of pond-reared shrimp may well be the bait shrimp market. In 1972, efforts were directed toward comparing suitablility of various species for both the edible and bait shrimp markets.

"White shrimp appear to be better suited for edible shrimp production because they grow to a larger size in the ponds," Parker notes, "but brown shrimp, which are available from the hatcheries almost year-round, appear to be the best bet for bait shrimp."

Bait shrimp production of as much as 1,000 quarts per acre of brown shrimp in 60 days is forecast. Retail price is $3.00 per quart, based on 80 to 100 shrimp per quart (individual shrimp size: about 4 grams). Six or seven crops may be harvested each year, once engineering problems are ironed out. Some quick arithmetic shows the gross income per acre per year to be nearing $18,000.

No net cost figures have been calculated for either edible or bait shrimp. A pilot production unit is planned for the 1973 growing season to determine actual production costs and investment returns for both types.

"The technology involved in raising



(Far left) Dr. Jack C. Parker, Texas A&M Sea Grant Mariculture Program Coordinator, uses a marsh buggy to inspect the shrimp ponds. (Left) Valve adjustment permits the water to drain from the shrimp ponds. Improved water circulation was a major factor leading to a record yield in 1972. (Above) Shrimp weighing 13.5 grams were harvested from the Texas ponds in October 1972.

shrimp was our first concern," Parker says, "and successful harvests indicate we're close. By this time next year, we should be able to provide the economic back-up needed."

The unique aspect of Texas A&M's mariculture work is that the investigators are identifying the problems in actual field experiments and then turning to the laboratory in search of answers.

"We simply decided that the only way to tackle the real problems associated with commercial mariculture was to set ourseleves up as an operating field unit," Parker, who is also with the University's Department of Wildlife and Fisheries Sciences, explains.

In spite of the progress the Sea Grant team has been able to report, problems still exist. Mortality remains the largest unsolved problem. Sometimes from 10 to 80 percent of the postlarvae die before harvest, either as a result of handling during the transportation stage from the hatchery to the ponds or from poor pond management. Disease and predators also contribute to the high mortality rates, and these factors head the list for future research plans.

Techniques for estimating survival are not adequate to determine proper feeding rates, and the supply of seed stock is still not consistent enough to satisfy the needs for a large-scale commercial operation.

Supplying an adequate number of seed stock is one of the problems under investigation by the National Marine Fisheries Service, Galveston.

"Part of the problem we face is the lack of knowledge scientists have about shrimp," Robert F. Temple, Deputy Director of the NMFS Gulf Coastal Fisheries Center, reported recently. "Little is known of their actual habits, how they migrate from the Gulf into estuaries, what they eat, or what types of diseases they are susceptible to. Something is lacking either in the nutrition or the water quality which has prohibited us from being able to mature females in captivity."

To provide consistently the postlarval forms needed for commercial shrimp farming, mature females must be raised so that they will breed in captivity.

One of the ways in which NMFS marine biologists are looking at the problem involves placing female shrimp in large wire containers suspended from offshore oil platforms. The work has been ongoing for several months, utilizing a platform off High Island, but it is still too early to draw any conclusions.

The Texas A&M mariculturists and NMFS marine biologists do not see shrimp pond culture as the answer to the world's protein problem. Pondgrown shrimp, like those caught in the Gulf, will be "luxury" food items, bringing a high market price.

"We hope that the cultivation of the shrimp as a crop will help satisfy the demand for the product," they say. "It will supplement the fishing catch rather than replace it."

The demand for shrimp is already great and increasing rapidly. Shrimp consumption in the United States exceeds 400 million pounds a year, and over half of this is imported.

At Texas A&M they're searching for a better shrimp cocktail—one that reduces the balance of trade payments in our seafood imports and at the same time provides new jobs for Texans and new uses for the state's coastal marsh lands. □

Like the oceanic birds that sailors regard as harbingers of foul weather, airmen of the Research Flight Facility brave the elements when storm clouds grow.

NOAA'S STORMY PETRELS

BY EDWIN P. WEIGEL

"There are old pilots . . . and there are bold pilots . . . but there are no old, bold pilots."

This solemn adage—dating back to World War II and perhaps before—has been intoned for years by flight instructors to fledgling pilots to instill in them a proper fear of stunting too close to the ground; ducking into thunderclouds; flirting with tornadoes, hail, and waterspouts; landing or taking off at a field socked in by bad weather; flying into a supercooled cloud waiting to deposit a load of ice; and an assortment of other quick ways for live pilots to become dead ones.

But the adage is not quite true. The veteran airmen of NOAA's Research Flight Facility, most of them on the high side of middle age, make a business of doing all these, and more, in the cause of science. Yet the RFF has never lost a man, an airplane, or even had a serious accident in its 12-year history.

"The chief reason is that all of our people are real professionals," explains Bill Callahan, Operations Chief of the Research Flight Facility. "They proved their worth elsewhere, either in military or civilian aviation, long before joining the RFF."

NOAA's RFF is not a large unit, as aviation organizations go. Operating on a two-million-dollar annual budget, it has only four aircraft, and these range from 14 to 19 years old. The oldest, ironically, is the glamour plane of the quartet, and flies highest and fastest. It is a twin-jet B-57A, a converted Martin bomber that rolled off the assembly line in Baltimore in 1953. It flies to 43,000 feet, cruises at 415 knots (477 miles per hour), and carries a crew of two—pilot and navigator/meteorologist.

The real workhorses, however, are a pair of four-engined DC-6B's built in 1957 and '58, loaded from stem to stern with complex electronic gear. These were augumented in 1970 by a four-turboprop C-130 Hercules that is awaiting full instrumentation.

The two DC-6's and the C-130 normally are manned on their scientific missions by a crew of eight—two pilots, navigator, flight engineer, two meteorologists, and two electronics specialists—plus the usual a visiting scientist or two, and perhaps a newspaper reporter.

A major function of the RFF has been to provide scientific data on hurricanes, in connection with the National Hurricane Research Laboratory, also based in Miami, and Project Stormfury, aimed at diminishing the force of hurricane winds. The RFF came into existence after a disastrous series of east coast hurricanes did an immense amount of damage in 1955. At first, the unit was a subsidiary to the National Hurricane Research Project. The U.S. Air Force provided and operated the aircraft while the Weather Bureau (now National Weather Service) installed and operated the meteorological instruments. When Air Force support ended, the Weather Bureau took over and began the 1960 season with three of the planes the RFF still flies today—the two DC-6's and the B-57—and began to take on additional missions such as studies of thunderstorms, hail suppression, rainfall enhancement, and snowfall redistribution.

In 1963 and 1964, sponsored by the National Science Foundation, the RFF made two expeditions to the Indian Ocean to conduct studies of the monsoons and other weather patterns in the Arabian Sea and Bay of Bengal.

But it is as hurricane hunters that the RFF flight crews have made their mark. It is a source of considerable pride to them to note that their unit has racked up more hurricane "penetrations"—flights into a hurricane eye—than any other single group of airmen. As of mid-August 1972, the total stood at 634. The average number of penetrations per man was about 150, and the record to date of 286 belonged to navigator William Fitch, now retired, who left the RFF in 1969 after flying through the eye of every major hurricane in the area since 1960, beginning with Donna and ending with Debbie, first hurricane to show encouraging evidence of modification by seeding.

RFF Operations Chief Bill Callahan, who himself has been with the RFF since 1962 and has 146 hurricane penetrations to his credit, explains that the Air Force and Navy, which also have crews going into hurricanes, "have such a high turnover that their people have not had an opportunity to build up totals like we have. Also, they usually don't make numerous penetrations on a single mission, as we do, but go in once, for a position report."

This accumulation of experience, Callahan believes, has been another factor in RFF's remarkable safety record. The practiced, almost casual ease with which they carry out their missions has been deceptive at times. A few observers along for a ride into a hurricane commented on an absence of hair-raising adventure. "There is always a danger in flying into a hurricane," says Navigator/Meteorologist Marshall Hatch, "and we don't ever forget it."

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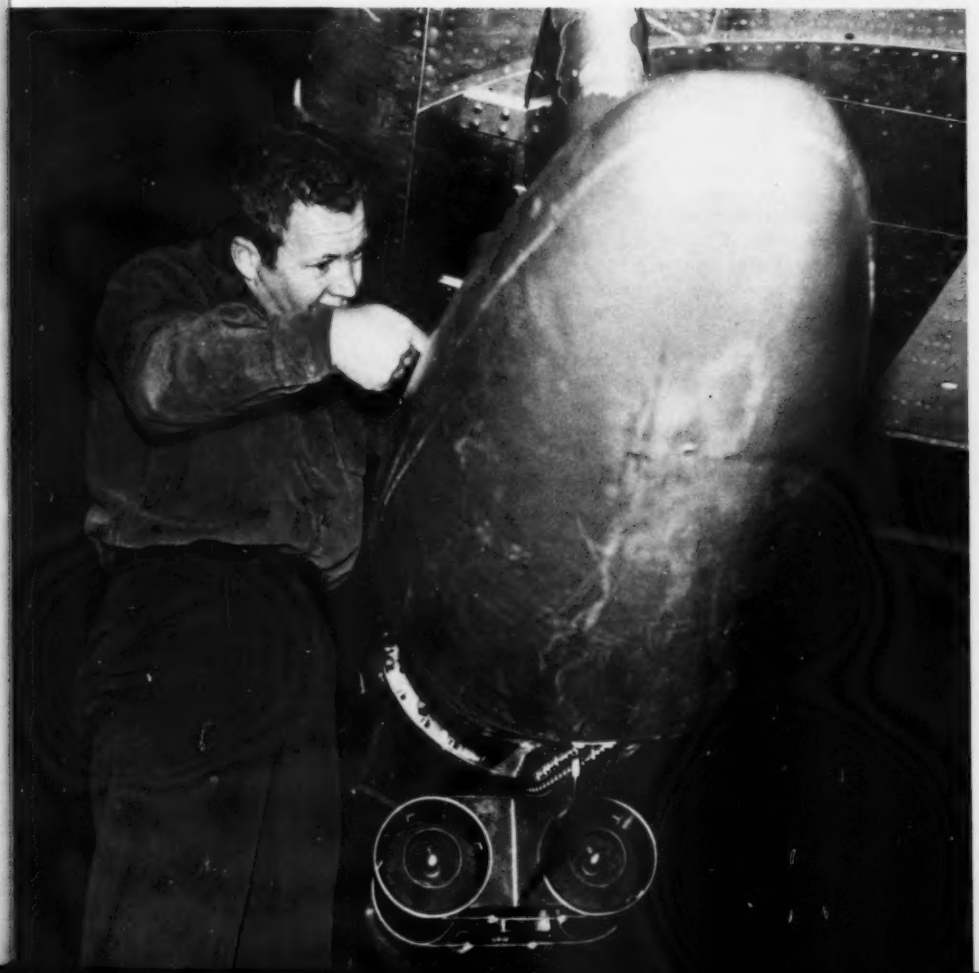

(Left) Brad Patten works on DC-6 wing-tip pod device for dispensing silver iodide horizontally. He developed and patented the equipment while serving as an RFF flight engineer. (Top left) Silver iodide released by the device left a hole in this stratus cloud seeded during ERL's Lake Erie snowfall project. (Above) RFF DC-6 on a cloud-seeding mission over the Bahamas.

The veterans are mindful that one hurricane hunter—a Navy aircraft with a crew of nine and two newspapermen—vanished without a trace in Hurricane Janet of 1955. Its last transmission ended with the words, "Beginning penetration . . ."

Over the years there have been thrills in abundance. One of the most notable occurred when Miami Herald science writer Richard Pothier was aboard an RFF plane reconnoitering Hurricane Gladys, in October 1968. He wrote:

"Our DC-6 labored into the storm's eye. The turbulence, ice and impenetrable clouds suddenly vanished. The sea 10,000 feet below was laced with whitecaps and driven by 80 mph winds. A few of us aboard the hurricane-hunting plane relaxed a bit. It was a mistake.

"I was strapped in my seat, talking with Harry F. Hawkins, Assistant Director of the National Hurricane Research Laboratory, who was leaning on a chart table in front of me.

"Suddenly, an immense, violent updraft picked the plane up and hurled it straight up as we passed through the other wall of the storm's ill-defined eye. I was forced down into my seat. Hawkins was flattened on the table.

"Then, an even stronger force drove the plane down, incredibly fast. Hawkins crashed to the plane's roof. He dented the metal ceiling. The Research Flight Facility's $1 million flying laboratory was falling through Hurricane Gladys at hundreds of feet a second.

"Then Hawkins—and everything else that wasn't bolted down—crashed back to the floor. Behind us, photo technician Frank Norimoto suffered the most. He wasn't strapped in. A 25-pound motion-picture camera slammed to the roof, broke a large hole in the plastic inner ceiling, then hit Norimoto as he was falling. He was injured—cut on the head, face and inner mouth, and injured in his back. He is in satisfactory condition at Mercy Hospital."

This incident, and others of lesser degree, point up the fact that the dangers of flying into a hurricane are not, as one might expect, a result of hurricane winds, which range from 74 to 190 miles an hour, but result instead from sudden changes in vertical motion. The airplane feels little or no effect from the horizontal wind, so long as it is reasonably smooth; the plane moves with that wind as does a leaf floating on a stream. But introduce a few updrafts and downdrafts, in close succession, and trouble begins.

This is why, as Marshall Hatch points out, "The big midwestern thunderstorm, although relatively small in area, is far more dangerous to penetrate in an airplane than a hurricane." He explains:

Except in rainbands or the wall cloud near the center, the turbulence you feel from a hurricane is usually relatively minor—we call it a washboard effect—continuous, but seldom violent. You may have this for six to eight hours in a typical hurricane mission. That, plus the continuous heat inside the aircraft, ranging up to 102 degrees and more because of all the heat-generating electronic equipment we carry, makes it quite exhausting after a while.

"When a hurricane makes landfall, it is then that the violent thunderstorms occur, because the combination of uneven heating and surface friction produces vertical currents of different velocities. We try to stay out of them at that time."

Contrasting vertical currents are even greater in big cumulonimbus clouds over the plains states. These produce the kind of weather no airplane can navigate safely. A special hazard of these big thunderheads is the hail they often contain, which has been the object of a series of research flights by RFF, although their pilots do not intentionally fly through hailstorms. "We have been hit by hail occasionally, but the damage to us was slight," said Callahan, who flies as a navigator/meteorologist. "We generally stay on the periphery of such storms." He added:

"The reason why is the terrific damage hail can inflict on an aircraft. There was one very serious incident involving an Air Force F-100 jet fighter, doing experimental work in Oklahoma. It came close to tragedy. The plane was accidentally vectored by ground radar into severe hail, much heavier than had been anticipated. Hailstones broke the cockpit canopy and knocked the observer cold. The pilot thought the observer was dead, but fortunately he was just stunned. The ground controller quickly vectored the plane back out of the storm and the pilot was able to make a safe landing. The F-100 looked like it had been battered with a sledge hammer."

Drawing the narrow line between an acceptable risk and an unacceptable one is ultimately the decision of the RFF's aircraft commanders, of which there are five. Chief pilot Fred Werley—who came to the RFF by way of the Air Force and United Air Lines, and also flew for a time as pilot of an executive plane for Bethlehem Steel—had a number of observations on his role:

"This is the most interesting and challenging flying I have ever done," he said. "We do exciting things—fly close to the ground, go into severe weather, buzz scientific surface installations, and so on. And it's all legal. It's done to support specific research and development programs, and with the approval of the Federal Aviation Administration.

"Sometimes we fly as low as 15 or 20 feet above the water, leaving a wake behind us like a motorboat. To do this, we have to fly manually, of course, instead of by automatic pilot, and we use a rader altimeter so sensitive it could respond to each tier of seats in a football stadium.

"At times, for safety reasons, it's not possible to meet all of a scientist's requirements. We appreciate that the scientists have reasons for wanting us to do certain things, but our pilots have the responsibility for saying, 'Yes, we will,' or 'No, we won't.' All

our aircraft commanders have a tremendous amount of experience—between 7,000 and 12,000 hours—before they even join our organization. The stiff requirements we have for an aircraft commander, or even for a copilot, are way above anybody else's because we are being asked to do things the average airline pilot flying, say, between New York and Miami, never encounters in his entire career."

Werley was quick to add, as does anyone associated with RFF: "And it's not just the pilots. Our mission is one whale of a big team effort. There isn't one guy—not the aircraft commander, or the navigator, or the lead meteorologist—who stands way above anyone else."

The planes that the RFF flies are unique in their instrumentation. Although much of it is vacuum-tube type and otherwise not as modern as RFF Director Howard Mason would like it to be, the electronic gear carried by each aircraft is varied and complex. When inside a storm, with all of its equipment going, an RFF plane is keeping a continuous record, most of it once each second, on photographs and magnetic tape, of the plane's position accurate to half of a mile, its altitude, airspeed, ground speed, the wind direction and speed, outside air pressure, humidity, liquid water, air temperature, sea-surface temperature, icing (if any), clouds (forward, to the sides and down), and radar images at various ranges, plus any special measurements a project scientist may

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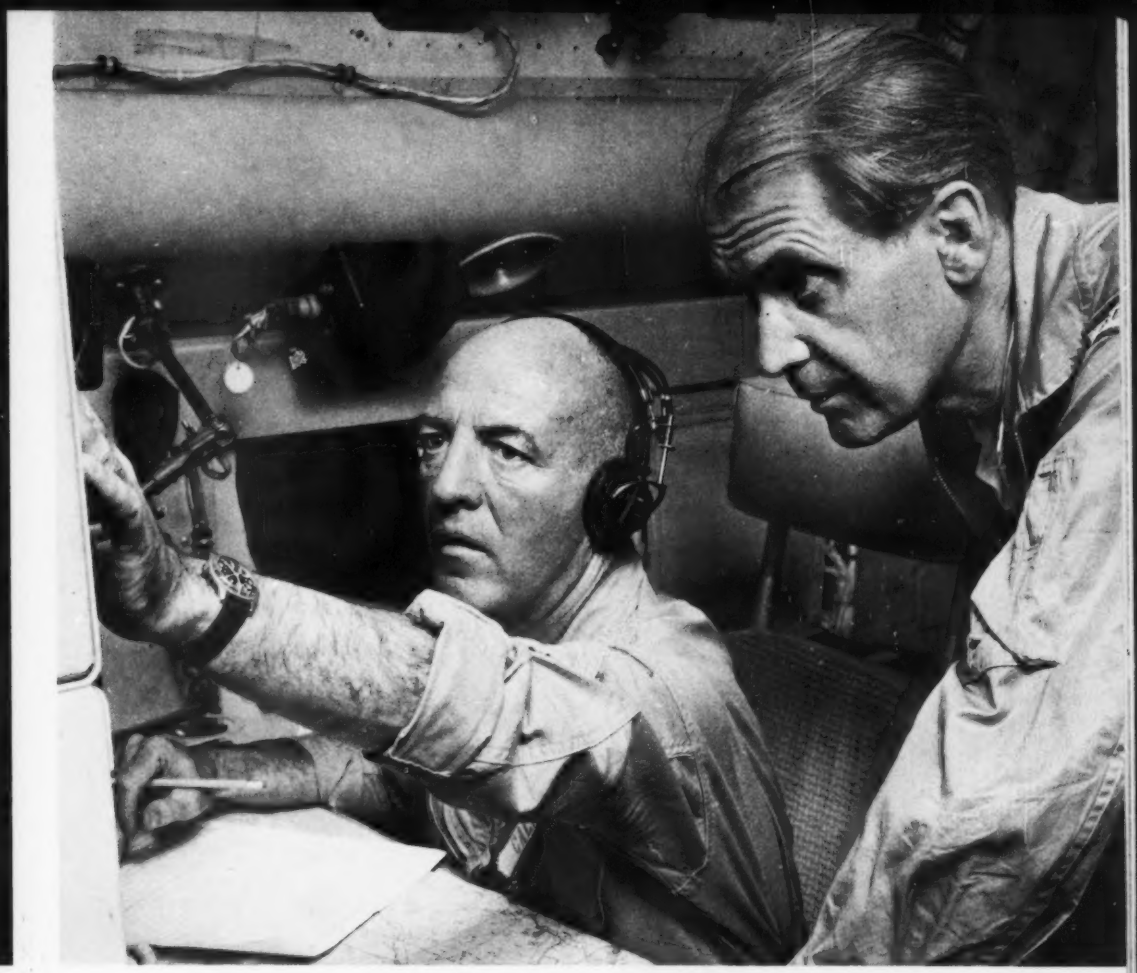

(Top left) A hurricane as it appears on the radarscope. RFF crews have made 634 flights into hurricane eyes. (Top right) RFF operations chief Bill Callahan, left, with Dr. Helmut Weickmann, Director of ERL's Atmospheric Physics and Chemistry Laboratory, on a hail research flight. (Left) Chief pilot Fred Werley at the controls of a DC-6. (Above) Dr. R. Cecil Gentry, Director of Project Stormfury, flies on hurricane seeding missions.

(Top left) RFF Director Howard Mason. (Top right) C-130, a four-turboprop cargo carrier built in 1958 and acquired by RFF in 1970, is larger, faster, and flies higher than the DC-6's. (Above) Former RFF navigator Bill Fitch holds the world's record for an individual of 261 flights across hurricane eyes. He flew into every major hurricane from 1960 to 1969. (Right) DC-6 40C and crew members H. Davis, W. Freedman, W. Gilbert, W. Callahan, S. Calvert, M. Hatch, R. Sundquist, D. George, R. Everts.

want for a specific mission.

There is so much special electronic equipment aboard that the aircraft engines are not used to generate electrical power for them, as is the case with conventional aircraft. A special gasoline-driven generator, putting out 30,000 watts, or enough current for a small city, is switched on when all the equipment is to go into operation. And there is so much heat generated that the RFF has never found an air-conditioning unit that will keep its planes comfortable at low altitudes in the tropics. During the Indian Ocean expedition, cabin temperatures hovered at around 102 degrees Fahrenheit.

The tremendous volume of data gathered on a mission goes into thick books of page after page of numbers, and thence to research centers.

The mind-staggering quantity of information about storms that is gathered by the RFF planes is often overshadowed by the more-glamorous role of Air Force and Navy reconnaissance aircraft whose task is to provide the information on which hurricane forecasts, watches, and warnings are based. The RFF does, on occasion, provide emergency operational reconnaissance of of Atlantic hurricanes, especially when a storm is close to Cuba, where U.S. military planes are forbidden to fly, but storm spotting and tracking for the National Weather Service is not the principal assignment.

The RFF is under administrative control of the Program Office of Weather Modification in the Environmental Research Laboratories in Boulder, Colorado. During the hurricane season, Dr. R. Cecil Gentry, Director of the National Hurricane Research Laboratory, has operational control.

The RFF's task is a much more complex one than routine reconnaissance, although the crews enjoy doing the latter.

RFF Director Howard Mason—youthful, crew-cut, grey-haired, and 44—says: "I think it's important for our people to do hurricane reconnaissance occasionally. It gives them a feeling of doing something obviously important. When you go out and locate the center of a storm, giving its latitude and longitude, its movement, size, and strength . . . there's a lot of satisfaction in that, because you know how important that information is to coastal populations. Research, being abstract, is hard to identify with. Doing these nonabstract jobs is extremely important in motivating a group to do what is essentially a difficult task and at times a dangerous one."

The RFF is an extremely versatile and resourceful organization. It can be ready to go any place in the world where its services are needed on 48 hours' notice. Most of its people have both a flight job and a ground job. Out in the field, the RFF does its own aircraft maintenance. The flight engineers are all FAA-licensed mechanics. They run their own engine checks, and even made an engine change after losing an engine on takeoff from Khartoum, Sudan.

One of the Facility's more interesting assignments was in connection with BOMEX in 1969—the Barbados Oceanographic and Meteorological Experiment, aimed at gathering data on air-sea interaction. Over a four-month period, the RFF crews averaged more than 100 hours of flying per month. They flew almost every day, and also did a lot of night flying.

Much of the RFF flight crews' time is spent away from their home base at Miami. This year, for example, there have been research missions over Lake Ontario for the International Field Year for the Great Lakes (IFYGL); hail and tornado research flights in Colorado and Oklahoma; snowstorm-redistribution experiments over Lake Erie near Buffalo, N.Y.; cloud-seeding tests from a base on the Caribbean island of Barbados; in addition to experiments conducted from Miami. And during much of the hurricane season there is always the chance of a quick trip to Puerto Rico for a new effort in Project Stormfury. There were two years—during the Indian Ocean expedition in '63 and '64—when the crews spent six months of the year away from home, on one mission or another.

The RFF made seven penetrations of Hurricane Agnes last June when that storm came so close to Cuba that the Defense Department restriction on military overflights applied. Said Marshall Hatch: "Agnes was not a textbook storm; it did not have much of a wall cloud and had a lot of cold air in it because it was an early-season storm. It barely made hurricane strength, even though the weather associated with it was extremely widespread." He added:

"Agnes wasn't anything like Edith, last year, which didn't feel like much at all until you were within 20 or 30 miles of the center and then it felt like a tornado. Edith had an eye maybe five to seven miles across—an extremely small, tight storm. That's the kind you have to be very, very careful of. Janet, the storm that claimed the Navy crew in 1955, was just such a storm. I flew that one a day or so earlier."

All in all, the Research Flight Facility's work is interesting, often exciting, and always demanding. Director Howard Mason, sums it up this way: "Our mission is to maintain and operate aircraft to support NOAA's environmental research. We provide the crews to man the aircraft, and most of the instrumentation. Our capability is worldwide. We have been engaged in research on hurricanes, tornadoes, thunderstorms, hail, lightning, snowstorms, precipitation enhancement, and a number of other meteorological or oceanographic phenomena.

"We supply the kind of specialized, instrumented aircraft a private contractor could not supply because of the high cost—aircraft that are nevertheless needed if we are to carry out NOAA's assigned missions.

"We now have under consideration a modernization plan for the RFF extending over the next few years by which we hope to phase out our older, limited performance aircraft and much of their instrumentation and substitute five long-range aircraft all of one type.

"Even if you didn't include weather modification, which now occupies much of our effort, there are other worthwhile research projects that could more than occupy us full time with this modernized unit.

"For example, there is a large unfilled need for aircraft in oceanographic research—also for research on the East Coast snowstorms project. In the latter, if we can help provide the means for sharpening forecasts of city-crippling snowfalls, large amounts of money can be saved.

"There is much more work to be done on measuring the parameters of a hurricane. We only measure a few points now. A large hurricane is a very difficult thing to describe. A major problem exists in determining if the storm has been modified, after seeding. You have to measure the total energy in the storm. This requires a complete knowledge of an entire, three-dimensional wind field . . . and the distribution of water in all forms in the storm. This is an enormous task—but it has to be approached.

"Investigation of severe storms—especially tornadoes—in the Midwest, in connection with the National Severe Storms Laboratory at Norman, Oklahoma, is another important area.

"The list is well-nigh endless, as you can see, and the rewards—well, they're beyond measure." □

It's one campus after another for the four NOAA Corps recruiters who interview hundreds of students

TO FIND OUR FUTURE OFFICERS

A TEAM OF NOAA PERSONNEL is searching the colleges and universities of America for science-oriented men and women with a zest for adventure.

They are looking for people who are prepared to sail to far-off places; to survey the land from Florida to Alaska and from Maine to Baja California; to probe the seas, the land below, and the skies above for hidden secrets; and to fly into the eye of the hurricane.

Only a few candidates can qualify, perhaps one out of four, for the posts to be filled are few and demanding in their requirements. But they are also rich in rewards for those who desire a somewhat different life in what for many is a humdrum world.

The searchers are recruiters for the NOAA Commissioned Corps. Their domain is the entire United States which, for recruiting purposes, is divided into three parts like the ancient Gaul of Caesar's time. One recruiting area extends from Maine to Puerto Rico and west to the Appalachians; another from there to the Rockies; the third from the Rockies to Alaska and Hawaii.

In this vast area, four men (only one is assigned to the job full-time) compress into a few months thousands of miles of travel by car and plane, mostly the latter, visiting some 80 colleges and universities and interviewing approximately 1100 possible candidates each year. Out of these interviews may come, in a typical year, 300 applications for the NOAA Corps, of which 250 may be recommended by the recruiting officers as suitable for consideration. These applications are presented to the Officer Personnel Board for consideration of appointment in the corps. The end result, when the board has completed its deliberations, will be the selection for the Corps of approximately 60 to 80 persons, about one out of every four candidates.

For the NOAA Commissioned Corps is the most selective of the nation's seven uniformed services, composed entirely of college graduates with engineering and science backgrounds. It is also the smallest, consisting—as of January 1973—of approximately 340 officers. There are no enlisted or non-commissioned personnel within the NOAA Corps as there are in other services.

Because the Corps is so selective, the few recruiters play a very important role in the lengthy process which begins with the interviews and ends months later with the swearing in of an applicant, usually as an ensign. The recruiter's task requires dedication, a rugged constitution, a knack for interviewing, and considerable tact. A sense of humor is also helpful.

Essential to a recruiter is a liking, or at least no serious objection to, flying. The Corps' first full-time recruiters were Commanders C. William Hayes and Sigmund R. Petersen. Hayes estimated he traveled about 40,000 miles, mostly by air, in the two years he served as a recruiter in 1964-66.

"It got pretty rugged at times," he recalled, "especially when our offices in Baltimore, Md., and Tampa, Fla., closed and their schedules were turned over to me." Those were the days when one of the duties of district officers was to visit educational institutions in their areas and interview possible applicants. This procedure has largely been dropped now, and the task is entrusted almost entirely to recruiters.

"The schedules for interviewing applicants at colleges and universities are now arranged a year or more in advance, but it wasn't quite that efficient in the 1960's" said Hayes. "You worked in appointments when and where you could and when the schedules for the extra offices were turned over to me, I really had to hop around."

One of his problems, Hayes recalled, was deciding what uniform to take along that would be suitable for the area he was visit-

ing. "On one occasion," he said, "I was in Norfolk, Va., where we were wearing our blue winter uniform. It was January. I went to the University of Florida in Gainesville, where they were wearing khakis and then on to the University of Puerto Rico, where they were in whites." He ultimately found the ideal solution: to take along all three uniforms.

"Both Petersen and I had full schedules as a rule, which meant long days of interviewing," continued Hayes. "On one occasion, I arrived at a university and found that its job placement office had scheduled 22 interviews. The interviews began at 8 a.m. and ran about one-half hour each. Toward the end of the day, I had to cut them down to 15 minutes to complete the schedule, finally finishing about 6 o'clock. On a day like this you get kind of shell-shocked."

Yes, recruiting can be rugged. Lt. Cdr. Frank Rossi estimated that in fiscal year 1971 he traveled 25,000 miles by air and drove another 5,000 miles.

"The interviews on campus are normally conducted in either a small room or a cubicle in a large partitioned room," said Rossi. "The usual schedule of 10 to 14 half-hour interviews in a day, with an hour off for lunch, can wear heavily on the interviewer, but once a schedule has been set by the college placement office, it has to be completed in the allotted time. As a break from this routine, I have held a number of walking interviews outdoors and in one instance, when I had 17 interviews without a break, I conducted an interview in a restroom."

Everyone advises the recruiter to go north early in the fall and south in the winter," Rossi added, "so I followed this advice and one of the few times I got snowed in was in El Paso, Texas."

The college job placement office usually sets up the schedule of interviews for the recruiting officer, although more attention now is being given to additional contacts with deans, instructors, and other college personnel.

Since recruiters naturally want to leave a good impression of the Corps at the institutions they visit, considerable tact at times is necessary in interviewing students. "When I was recruiting, Selective Service was calling up large numbers for the Army," said Hayes. "Obviously, we didn't want to enroll in the Corps students whose primary interest was avoiding military service and who would leave the Corps in two or three years after their draft requirements had been met. But how do you find this out? You can't just ask,

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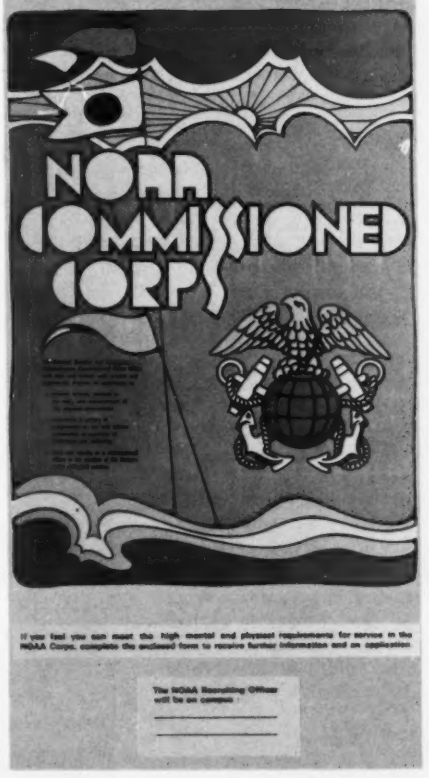


'You're not trying to get into the Corps just to avoid the draft' "?

It was a subject that had to be handled, said Hayes, with some delicacy, while at the same time determining "whether here was a man who wanted to make a career of the Corps.

"We struck out on some," he said. "On others, we didn't."

Tact was also required with students obviously not qualified for physical reasons, for the Corps' physical requirements are quite strict, including corrected 20/20 vision with glasses.

"I was waiting one time to interview the next student," said Hayes, "when I heard a tapping, tapping, tapping down the hall. It stopped in front of my door and in walked a student with a cane who was completely blind. He'd had read to him much of the Corps' material I'd had sent out to the university, but had apparently missed the physical requirements. He wanted to work on a ship. I had to tell him, as considerately as I could, that one of the requirements was good vision."

The recruiting program now is a far cry from the recruiting practices used years ago, with the extended interviews, physical exams, and detailed forms that have to be filled out. The latter now include a psychology test known as the "Strong Vocational Interest Blank," designed to improve the selection of career-motivated officers. While the retention rate in the NOAA Corps is better than the other uniformed services (42 percent for the three-year period from 1967 to 1969, the latest figures available, the highest in 20 years), it is not as good as Rear Admiral Harley Nygren, its Director, would like it to be.

Years ago, when the Commissioned Corps was part of the Coast and Geodetic Survey, the predecessor of NOAA's National Ocean Survey, it was sufficient if the applicant was young and in reasonably good health. One veteran officer recalled that he was looking for recruits when a college graduate walked in and said he was seeking work. "We've got just the job for you," said the officer. "Sign here."

Three days later, the recruit was on a dock in Adak in the windswept Aleutians waiting for his ship to come in. He had never been aboard a ship or west of Philadelphia. Three months later, when the ship returned to Seattle, he quit.

"We don't do it that way any more," remarked Lt. Cdr. Charles Y. Molyneaux, Jr., recruiter for the western Pacific area.

"We tell it like it is now. We lay it on the line. Those are our instructions from Admiral Nygren. We want them to know exactly what they're getting into. Then, if they sign up, there's more chance of their making a career of the Corps.

"I tell the students that they can look forward during their first 18 to 24 months to being basically 'ship drivers.' That's staying on the ship's bridge for four hours on, four hours off, and so on. It's boring, it's tiring, it's often uncomfortable, especially in bad weather, but it's important. I recall that one student remarked, after I told him what he could look forward to, that 'I like what you've told me better than the story I got from company representatives.' "

NOAA Corps recruiters have to vie for bright young men not only with other uniformed services, but with industry representatives as well.

With the Corps open now to women, Molyneaux said he has been interviewing at least one coed on each campus.

"I talked to one mixed group where a coed asked, 'What would women do aboard a ship?' I told her, 'Just the same as the men; and she said, 'Wow! That's all right.' "

Molyneaux said one of the things he tries to find out from women applicants is whether they are really serious about a career in the corps or are primarily interested in getting married.

Several coeds in Seattle, Wash., who appeared interested, were taken on a tour of a ship. Subsequently, discussing among themselves what they'd seen while Molyneaux was out of the room, one appeared concerned over the fact that the officers' rooms had connecting bathrooms.

"Wouldn't that make us rather conspicuous?" she asked.

"Oh no," remarked her companion. "I'd wear pajamas."

Another student, who appeared quite interested in joining the Corps, was accompanied by his wife. Telling it like it is, Molyneaux asked her, "What would you think of your husband being away at sea for four months at a time?" She replied, "Well, I wouldn't like it, but if that's what he wants . . ." and her voice trailed off.

Molyneaux said most students he interviewed were serious, asking many questions about the Corps. On the other hand, some were obviously not qualified, like the student who drifted in and inquired whom he represented.

"We're interviewing students for the NOAA Commissioned Corps," replied Molyneaux.

Lt. (jg) William T. Turnbull, who coordinates the recruiting program, interviews a prospective member of the NOAA Commissioned Corps.

A puzzled look crossed the student's face. "What's commissioned?" he asked.

The NOAA Corps recruiters now are Molyneaux, who works out of Seattle and covers the Pacific coast, including Alaska and Hawaii; Lt. (jg) Robert B. Zider, stationed in Kansas City, Mo., who covers the mid-continent; Lt. (jg) Brent G. Harris in Norfolk, Va., whose territory is the Atlantic seaboard; and Lt. (jg) William T. Turnbull, who coordinates the recruiting program from NOAA Corps headquarters in Rockville, Md. In addition, Lt. Cdr. Joseph W. Dropp, in charge of the NOAA Officer Training Center, Kings Point, N.Y., interviews students at maritime academies in the northeast. Two retired commissioned officers—Captain William M. Scaife of Clemson, S.C., and Captain Clarence A. George of Louisville, Ky.—serve as volunteer recruiters at colleges in their areas. Zider is a full-time recruiter, while the others are active in recruiting from October through February of each school year.

Prior to the opening of the school year, a schedule is prepared for each recruiter. In 1972-73, the recruiter in Norfolk will visit 31 universities and colleges in Virginia, North Carolina, Florida, Georgia, Pennsylvania, New York, Massachusetts, New Jersey, New Hampshire, Maine, Connecticut, Rhode Island, and Delaware.

The Kansas City schedule includes 24 institutions in Michigan, Illinois, Indiana, North Dakota, Minnesota, Iowa, Wisconsin, Ohio, Texas, Colorado, South Dakota, New Mexico, Arizona, Missouri, Kansas, Tennessee, and Mississippi. From Seattle, visits will be made to 20 scholastic centers in Alaska, Oregon, California, Nevada, Utah, Hawaii, Washington, and Idaho. Some institutions are visited twice, during the fall and winter terms.

Following interviews, those indicating an interest in applying for the Corps are given the necessary forms to fill out. These include an application for a commission, a visual acuity form, a service agreement (a minimum of three years of service is required), the psychology test and reference letters from recent professors and/or employers. An official transcript of college grades must also be furnished. The processing of an application usually requires two to four months.

The completed forms are submitted by the recruiter to the Commissioned Personnel Division at NOAA headquarters. The recruiter also submits an evaluation of each applicant, including his appearance, intellectual qualities, personality, maturity, motivation, attitude towards service, and his interest in and knowledge of the Corps' work.

This somewhat voluminous material is then arranged in standard format by the Commissioned Personnel Division staff and submitted to the Officer Personnel Board, consisting of Captains John O. Phillips, Leonard S. Baker, John O. Boyer, Arthur R. Benton, Jr., Roger F. Lanier, and Comdr. Kelly E. Taggart. The board makes its recommendations to Admiral Nygren.

The appointee takes a physical examination and undergoes a security check. If he passes, he is sworn in, usually as an ensign (at a higher rank if he has prior military experience), receives 16 weeks of training at Kings Point and at NOAA's Atlantic Marine Center in Norfolk and then reports to his first assignment, usually aboard one of the 30 vessels comprising the NOAA Fleet.

The candidate being sought today for the NOAA Corps is generally a young person with a good academic record, a record of personal achievement and growth, a high standard of personal conduct, a desire to accomplish productive work, and an interest in the environment, with a desire to take part in active field projects in direct contact with the problems of nature. The candidate should not be totally dedicated to a very narrow field, but should be capable of broadening his interests, furthering his education in allied fields, and developing his potential as a leader and administrator.

His service will combine aspects of a military life with NOAA's scientific mission. This combination provides an opportunty for engineering and scientific graduates to do technical work in the field and also serve their country as commissioned officers. The Corps is especially oriented toward those who desire travel, variety in assignments, and meeting nature on her own terms. A good deal of hydrographic surveying is done each year in Alaskan waters.

Admiral Nygren is guiding this group of men and women into a more important and expanded role, a role which envisions a greater participation in oceanographic activities and fisheries research with the inclusion in the NOAA Fleet of 14 vessels from the National Marine Fisheries Service. These, plus the National Ocean Survey vessels, resulting of some of the world's most modern oceanographic and fisheries research vessels. Nygren said the addition to the fleet of the fisheries vessels is expected to require the services of at least 50 more commissioned officers as billets open on the vessels, especially in operations and administrative management.

The NOAA Corps Director said the diversity of jobs in the organization—at sea, on land, and in the air—makes a career in NOAA attractive, despite some of its shortcomings, such as lengthy periods at sea. For those who desire to see the world, NOAA ships travel to many foreign ports.

Officers on sea duty engage in physical oceanographic and deep ocean surveying, hydrographic surveys, shiphandling, and geophysical investigations. They learn to become ship operators as well as engineer-scientists. Many of them obtain command of their own ships.

Those on mobile shore duty get a chance to view the length and breadth of the United States. This land duty may be from some fixed location, but generally it is on a field party working in geodesy, photogrammetry, hydrography, satellite triangulation, flight duty, or tides. Fixed shore duty may be in any of NOAA's components, in operational, research, staff, or administrative positions.

A typical 30-year career with the NOAA Corps will include 15 years of fixed shore duty, nine years of sea duty, and six years of mobile shore duty.

Among the basic rules which guide the corps in recruiting new members, Nygren said, is the desire for a "geographic spread" so that different areas of the country will be represented in the service; a diversity in backgrounds, including a satisfactory input of minorities, and women; and a greater emphasis on students versed in oceanographic sciences and those with experience at sea.

To achieve this latter aim, an increased effort is being made to recruit graduates of U.S. and state maritime schools and young naval officers who are now being phased out of service as the Navy is being reduced. Legislation is also being sponsored authorizing the transfer of officers between the Navy, Coast Guard, and NOAA without their having to resign and be reappointed, often at a lower grade.

"I am very encouraged by what I see ahead of us," said Nygren. "Since the Commissioned Corps was established in 1917, it has played a vital role, both in peace and in war. I am confident it has a still more vital role to play in the future, especially with the increased emphasis being placed on the ocean and its resources."

"I am also encouraged," he added, "by the caliber of the people now applying for the Corps. We anticipated that as the draft was phased out, the number of applications would decline, but this has not happened. And we are getting applicants who are more serious and more knowledgeable, who show an eagerness to pursue a career that will not only help them, but will also help improve the world we live in.

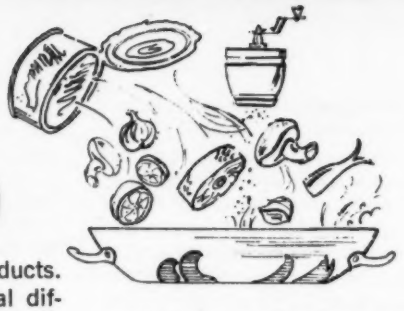
"I look forward to having more women serving in the Corps as the equals of men and we welcome to the Corps minorities from every facet of American life. This is a fine group of men and women and we welcome anyone who can measure up to our standards."

The standards are high. Candidates for appointment in the NOAA Corps must hold a baccalaureate or higher degree in engineering, mathematics, physics, oceanography, meteorology, or other physical, geophysical, or biological science discipline from an accredited college, maritime academy, or university. They must be American citizens between the ages of 20 and 26, although in some cases the age limit may be extended for candidates with related experience in the armed forces. Physical requirements are high, including uncorrected vision of 20/20 in each eye, although waivers may be granted for visual acuity not less than 20/70 in each eye if corrected to 20/20. And candidates must be between 5 feet 4 inches and 6 feet 6 inches tall.

If you fill the bill, the Corps would be glad to have you apply. □

Sea Fare

TAKE A CAN OF SEAFOOD



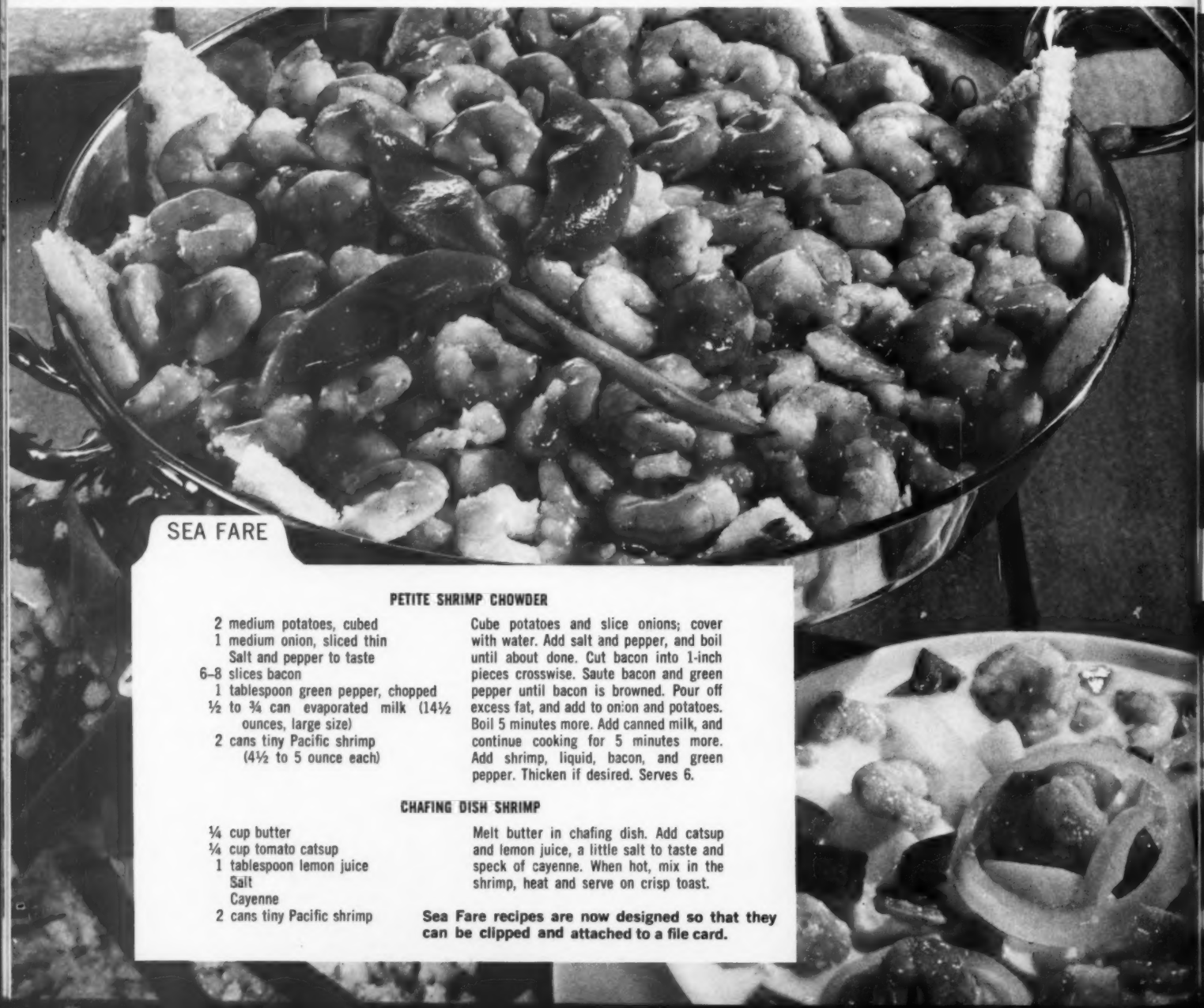
Tuna, clams, sardines, shrimp, oysters, salmon, crabmeat, and other seafoods are available to the cook year-round, thanks to the amazing progress made in canning procedures since the industry began in America during the early 1800's.

Although tuna was not canned until early in the 20th century, the phenomenal growth of the California-based tuna industry has been such that production now equals or exceeds that of most other canned fishery products. Today, tuna is canned in several different styles, including solid-pack, chunk-style, and grated or flaked.

From the opposite coast comes the Maine sardine—not really a sardine at all, but a variety of small, soft-boned herring. Sardines are canned in various types of oil, as well as in mustard and tomato sauces.

But whichever canned seafood you choose, it will be high in protein content, convenient to store and prepare, with little waste—and, most important of all, delicious to eat.

Saluting the annual convention of the National Canners Association, meeting this month in San Francisco, the National Marketing Services Office of the National Marine Fisheries Service presents a set of recipes featuring canned seafoods.



SEA FARE

PETITE SHRIMP CHOWDER

- 2 medium potatoes, cubed
- 1 medium onion, sliced thin
- Salt and pepper to taste
- 6–8 slices bacon
- 1 tablespoon green pepper, chopped
- ½ to ¾ can evaporated milk (14½ ounces, large size)
- 2 cans tiny Pacific shrimp (4½ to 5 ounce each)

Cube potatoes and slice onions; cover with water. Add salt and pepper, and boil until about done. Cut bacon into 1-inch pieces crosswise. Saute bacon and green pepper until bacon is browned. Pour off excess fat, and add to onion and potatoes. Boil 5 minutes more. Add canned milk, and continue cooking for 5 minutes more. Add shrimp, liquid, bacon, and green pepper. Thicken if desired. Serves 6.

CHAFING DISH SHRIMP

- ¼ cup butter
- ¼ cup tomato catsup
- 1 tablespoon lemon juice
- Salt
- Cayenne
- 2 cans tiny Pacific shrimp

Melt butter in chafing dish. Add catsup and lemon juice, a little salt to taste and speck of cayenne. When hot, mix in the shrimp, heat and serve on crisp toast.

Sea Fare recipes are now designed so that they can be clipped and attached to a file card.

CURRIED TUNA WITH FRUITED RICE

- 1 cup finely chopped peeled apple
- ¼ cup chopped onion
- ¼ cup butter or margarine
- 3 tablespoons flour
- 1½ teaspoons curry powder
- 1 teaspoon salt
- 2 cups milk or half and half (half milk, half cream)
- 2 cans (7 ounces each) tuna, drained and broken in large pieces
- 2 tablespoons finely chopped preserved ginger or chutney
- 1 tablespoon lemon juice

Cook apple and onion in butter or margarine until tender. Blend in flour, curry powder, and salt. Add milk or half and half; cook stirring constantly until thickened. Add tuna, ginger or chutney and lemon juice; mix carefully. Heat. Serve over hot Fruited Rice. Makes 6 servings.

FRUITED RICE

- 1 can (13¼ ounces) pineapple tidbits
- 2 cups liquid (pineapple juice and water)
- 2 cups precooked rice
- ¼ cup light raisins

Drain pineapple tidbits; save syrup. Combine pineapple syrup and add water as needed to make 2 cups liquid. Cook rice in liquid as directed on package label. Fold in pineapple tidbits and raisins. Serve with Curried Tuna. Makes 6 servings.

MAINE SARDINE CANAPES

- 3 cans (3¾ or 4 ounces each) Maine sardines
- ½ cup butter or margarine, softened
- 2 tablespoons prepared mustard
- 10 slices sandwich bread
- Pimiento strips

Drain sardines and split in half lengthwise. Combine butter and mustard. Spread bread with mustard-butter. Remove crusts. Cut each slice of bread into thirds. Place a sardine half on each piece of bread. Garnish with pimiento strips. Makes 30 canapes.

CRISPY FRIED MAINE SARDINES

- 4 cans (3¾ or 4 ounces each) Maine sardines in tomato sauce
- 1 can (8 ounces) tomato sauce
- 1 cup dry bread crumbs
- ⅓ cup grated Parmesan cheese
- ½ cup flour
- Cocktail sauce

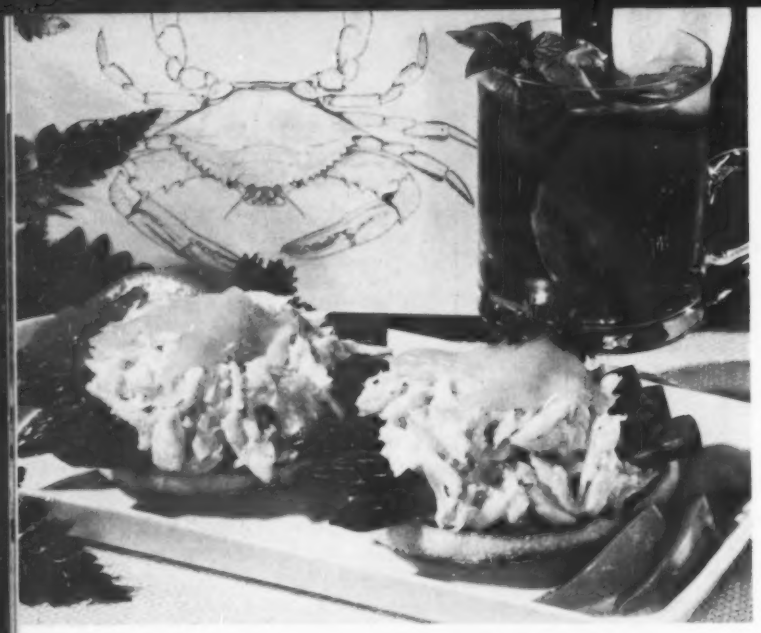
Drain sardines and reserve the sauce. Combine tomato sauce and sardine sauce. Combine crumbs and cheese. Roll sardines in flour, dip in tomato sauce, and roll in crumb mixture. Place in a single layer in a fry basket. Fry in deep fat, 350° F., for approximately 1 minute or until brown. Drain on absorbent paper. Serve with cocktail sauce. Makes approximately 24 hor d'oeuvres.

MAINE SARDINE DIP

- 1 can (3¾ or 4 ounces) Maine sardines
- 1 package (8 ounces) cream cheese, softened
- 1 tablespoon milk
- 2 tablespoons chopped parsley
- 1½ tablespoons lemon juice
- 2 teaspoons grated onion
- 1 teaspoon steak sauce
- 1 teaspoon Worcestershire sauce
- ¼ teaspoon liquid hot pepper sauce
- Chopped parsley
- Assorted chips, crackers, or raw vegetables

Drain sardines and flake. Cream the cheese and milk. Add remaining ingredients except parsley and chips. Add sardines and mix thoroughly. Chill. Sprinkle with parsley. Serve with chips, crackers, or vegetables. Makes approximately 2 cups of dip.

continued



SUNNY CRAB SANDWICH

- 1 pound blue crabmeat, fresh, frozen, or pasteurized, or other crabmeat
- 1 cup sliced almonds
- ½ cup chopped celery
- ½ cup mayonnaise or salad dressing
- 2 tablespoons lemon juice
- 6 toasted buttered English muffins
- 12 cooked asparagus spears (or more, as desired)
- 6 slices (1 ounce each) cheddar cheese
- Paprika
- Tomato wedges

Thaw frozen crabmeat. Drain crabmeat. Remove any remaining shell or cartilage. Combine almonds, celery, mayonnaise, lemon juice, and crabmeat. Arrange muffin halves on a cookie sheet, 15 by 12 inches. Place one or more asparagus spears on each muffin half. Cover asparagus and muffin with crab mixture. Cut each cheese slice diagonally into quarters. Place 2 triangles on each sandwich. Sprinkle with paprika. Bake at 400° F. for 15 to 20 minutes or until heated through and cheese is melted. Serve with tomato wedges. Makes 6 servings.

SCALLOPED OYSTERS WITH HAM

- 2 cans (12 ounces each) Pacific oysters or other oysters, fresh or frozen
- 2 cups cracker crumbs
- ½ cup cooked chopped ham
- ½ cup chopped green pepper
- Dash pepper
- ½ cup butter or margarine
- ¼ cup sherry
- Oyster crackers

Thaw frozen oysters. Drain oysters. Combine crumbs, green pepper, ham, and pepper. Arrange ½ the oysters in a well-greased baking dish, 12 by 8 by 2 inches. Dot oysters with ½ the butter and sherry. Cover with ½ the crumb mixture. Repeat layers. Arrange oyster crackers on top. Bake in a very hot oven, 450° F., for 20 to 25 minutes or until lightly brown. Makes 6 servings.

SUWANNEE SOUND OYSTER PIE

- 2 cans (10 ounces each) fresh or frozen oysters (about 2½ cups oysters and liquor)
- 6 slices bacon, diced
- ½ cup thinly sliced celery
- ½ cup finely chopped onions
- 1 package (10 ounces) frozen peas and carrots, partially thawed and broken apart
- ½ cup flour
- 1½ teaspoons salt
- 1 teaspoon pepper
- 2 cups milk
- 1 cup diced (¾ inch) cooked potatoes
- ¼ cup diced pimiento
- 2 cups prepared biscuit mix
- 1 tablespoon melted butter, margarine, or cooking oil

Thaw frozen oysters; drain and reserve ½ cup liquor. Cook bacon until crisp; drain on paper toweling; reserve 2 tablespoons dripping. Cook celery and onion slowly in reserved drippings until celery is tender. Stir in peas and carrots; heat. Blend in flour and seasonings. Gradually stir in 1½ cups milk and reserved oyster liquor. Cook until thick, stirring constantly. Fold in potatoes, pimiento, oysters, and bacon; heat. Pour into shallow 2-quart baking dish, 12 by 8 by 2 inches. Combine biscuit mix and remaining ½ cup milk; stir with fork to form a soft dough. Turn onto lightly floured board; knead lightly 8 to 10 times. Roll into a rectangle 8 by 12 inches or the size of the top of the baking dish. Cut into 12 equal portions. Arrange biscuits on oyster mixture; brush tops with melted butter, margarine, or oil. Bake in a hot oven, 425° F., for 15 minutes or until hot and biscuits are done and lightly browned. Makes 6 servings.

CLAM-CHICKEN CHOWDER

- 2 cans (7½ or 8 ounces) minced clams
- 1 can (5 ounces) boned chicken
- 2½ cups clam liquor and water
- 1 bottle (8 ounces) clam juice
- 1 cup diced potato
- 1 can (7 or 8¾ ounces) corn
- ½ cup sliced carrot
- 2 tablespoons chopped onion
- 1 tablespoon chopped pimiento
- 1½ teaspoons chicken seasoned stock base
- ¼ teaspoon thyme
- Dash pepper
- 1 tablespoon chopped parsley

Drain clams and reserve liquor. Cut chicken into ½-inch pieces. Combine liquids, vegetables, and seasonings in a 3-quart saucepan. Cover and simmer for 15 to 20 minutes or until vegetables are tender. Add clams, chicken, and parsley. Heat. Makes 6 servings.

SALMON CHEESE SOUP

- 1 can (1 pound) salmon
- 1 can (10 ounces) frozen cream of potato soup
- 3½ cups salmon liquid and milk
- 1 vegetable bouillon cube
- 1 cup grated process cheese
- 1 teaspoon caraway seed (optional)
- Dash pepper

Drain salmon, reserving liquid. Break salmon into large pieces. Combine soup, salmon liquid and milk, and bouillon cube; heat until soup is thawed, stirring occasionally. Add cheese, caraway seed, pepper, and salmon. Heat until cheese melts, stirring occasionally. Sprinkle with parsley. Makes 6 servings.

SALMON CREOLE

- 1 can (1 pound) salmon
- ¼ cup butter or margarine
- 1½ cups coarsely chopped onion
- ½ cup coarsely chopped green pepper
- 1 medium clove garlic, minced (about ½ teaspoon)
- 2 tablespoons flour
- 1 can (1 pound, 12 ounces) tomatoes
- 1 can (8 ounces) tomato sauce
- 1 teaspoon salt
- 1 teaspoon basil
- ½ teaspoon sugar
- ¼ teaspoon leaf thyme
- 1 medium bay leaf
- Dash of cayenne or liquid hot pepper sauce
- 6 servings hot buttered seasoned cooked rice

Drain salmon. Break salmon into large bite-size chunks; set aside. Melt butter or margarine in large (3 or 4 quart) saucepan. Add onion, green pepper, and garlic; cook until onion is almost tender. Stir in flour. Add tomatoes, tomato sauce, and seasonings. Simmer for 20 minutes, stirring occasionally. Remove bay leaf. Fold in salmon chunks; heat. Serve over hot buttered seasoned cooked rice. Makes 6 servings.

New Program To Prevent Porpoise Deaths Announced by Commerce Secretary Peterson

Secretary of Commerce Peter G. Peterson has announced a program designed to save porpoises from accidental death in the nets of the United States' tuna fleet.

"When one porpoise dies in a tuna net, that is one death too many," Secretary Peterson said in October. He added: "Enactment of the Marine Mammals Protection Act places in the Department of Commerce's keeping the protection of this magnificent mammal as well as other important species whose preservation I regard as absolutely essential.

"With President Nixon's support," he continued, "we have launched a research effort that should give us fresh insights both into porpoise behavior and into new methods of tuna fishing. Immediate action will include encouraging all tuna fishermen to use the latest methods and equipment, including a fine mesh panel in nets."

The Secretary issued the report of a committee headed by Dr. Dayton L. Alverson, Director of the National Marine Fisheries Service's Northwest Fisheries Center. The committee, reporting to the Secretary through Dr. Robert M. White, NOAA Administrator, recommended an intensive effort to save the marine mammals.

About half of the nation's yellowfin tuna catch is taken by seeking out schools of porpoise, which travel in tight association with tuna. Schools are encircled with the large purse seines, and, as the nets are drawn together, porpoises on or near the surface can become entangled in the nets and drown.

The committee, Secretary Peterson said, found that approximately 315,000 porpoises died in tuna nets in 1970 and 205,000 in 1971. It is, however, impossible to conclude from these figures whether the porpoise population is or is not being seriously affected by the tuna fisheries, he said.

He pointed out that whether or not the accidental kill materially affects the overall population, the Commerce Department is committed to the conviction that it must be brought as close and as quickly as possible to zero.

Many techniques for saving porpoise have been tried. In 1970, Harold Medina, a tunaboat captain, devised a panel to be incorporated in tuna seines, using smaller-mesh webbing which makes it more difficult for porpoises to become entangled. Medina nets are in use on more than 50 boats.

Secretary Peterson endorsed the committee's proposal that NOAA should immediately undertake efforts to substantially reduce losses and, simultaneously, launch research programs in gear development and biological studies to help attain the first objective.

Any solutions, he said, must be capable of practical use by the fishing fleet, which probably would be forced to fish under foreign flags if subjected to overly restructive regulation.

The Secretary endorsed the committee's recommendations that:

—All tuna seiners be encouraged to use the Medina panel;

—A cooperative Federal-industry program be launched to teach tuna fishermen to use more efficiently "backing-down" techniques allowing porpoises to escape over nets;

—A program be undertaken to improve fishing techniques and gear;

—Information be acquired on the behavior of tuna and porpoise schools in nets;

—Population assessments of porpoise be undertaken;

—An intensified effort be made to establish biological parameters vital to the impact of kill to population; and

—Investigations of the behavior of porpoises and tuna to artificially-induced stimuli.

Secretary Peterson said the committee believes short-range solutions can best be attained by modifying existing techniques, perhaps by using a deeper Medina panel, by changing backing-down tactics, by developing a duel purseline seine, and by developing net "sorting panels." He noted the recommendation that an aerial assessment of porpoise population be undertaken this year.

He announced an advisory committee would be appointed to work with the National Marine Fisheries Service, from the ranks of leaders in the fishing industry, conservation groups and scientists.

Universities of Wisconsin, Hawaii Designated as Sea Grant Colleges

The University of Wisconsin and University of Hawaii have been designated by the Secretary of Commerce as Sea Grant Colleges, the fifth and six colleges to be so designated.

The first four Sea Grant College designations were awarded in 1971 to the University of Washington, University of Rhode Island, Oregon State University, and Texas A&M University.

To be eligible for such designation, an institution must have a demonstrated record of superior performance for a minimum of three years in Sea Grant programs that encompass research, development of the marine environment, education and training of marine scientists and technicians, and an effective marine extension or advisory program.

The Sea Grant Program at the University of Wisconsin was the first on the Great Lakes, and has built on existing competence at the University in scientifically treating important problems of the Great Lakes and the ocean.

The Sea Grant Program at the University of Hawaii is tailored to the needs and opportunities of the Hawaiian Islands and U.S. Trust Territories. An ambitious program in aquaculture includes work with such exotic species as mahimahi, octopus, and Samoan crab.

NOAA Responsibilities Increased by Laws on Coastal Zone, Marine Mammals, Ocean Dumping

Three Federal laws of major importance to NOAA were passed by Congress and signed by President Nixon during October. The new laws give the Secretary of Commerce responsibility for management of the Nation's coastal zone and for protection of marine mammals, and an active role in the regulation of ocean dumping. NOAA will conduct these programs for the Secretary.

To protect, develop, and—if possible—restore coastal lands and waters, the Coastal Zone Management Act makes the Secretary of Commerce responsible for issuing grants to individual States for up to two-thirds of the cost of creating and administering coastal zone management programs and for up to half the cost of acquiring and developing estuarine sanctuaries. Under the Act, the Department will continually review the performance of State programs, and will report annually to the Congress. Federal agencies are required to conduct their activities in a manner consistent with the State programs, to the greatest possible extent.

The Marine Mammals Protection Act establishes a moratorium on the taking or importing of marine mammals and marine mammal products, except with a permit issued by the Secretary of Commerce in the case of whales, porpoises, seals, and sea lions or by the Secretary of the Interior for polar bears, walruses, sea otters, and manatees. The Act allows permits to be issued for taking of marine mammals for research or public display, but for other purposes only after it has been determined that the taking of a particular species is consistent with sound resource management. Incidental catches of marine mammals during commercial fishing operations are excepted from the moratorium for two years, while research is conducted.

The Marine Protection, Research, and Sanctuaries Act prohibits transportation of materials for dumping in United States waters, except with a permit issued by the Administrator of the Environmental Protection Agency. The Act requires the Secretary of Commerce to conduct a program of monitoring and research on the effects of such dumping and to begin comprehensive research on the long-range effects of pollution, over-fishing, and other changes in ocean ecosystems brought about by man's activities. In addition, the Secretary of Commerce is authorized to designate certain ocean areas as marine sanctuaries, for the purpose of preserving or restoring their conservation, recreational, ecological, or esthetic values.

Island Site of NWS Station Transferred To Honduras

The U.S. weather station on Great Swan Island in the Caribbean has a new landlord.

On September 1, sovereignty over the tiny island—which is about two miles long by half-a-mile wide—was formally transferred by the United States Government to the Republic of Honduras. Along with it went Little Swan Island—about one-and-a-half miles wide by three-tenths of a mile—and a limestone speck called Booby Cay.

The U.S. weather station there will continue to function much as before, with minor differences in reporting procedures. There are five National Weather Service personnel of U.S. citizenry on the island. Patrick Ianelli is the Official in Charge. Under the treaty transferring sovereignty, the Honduran Government has agreed to take on responsibility for maintenance of some of the facilities formerly maintained by the U.S.

Sovereignty over the Swan Islands, which lie about 95 miles off the coast of Honduras, has been contested for many years. The U.S. renounced its claim to them as a gesture of inter-American good will. Only Great Swan is populated.

The U.S. has had a fulltime weather station on the island, which is extremely important in hurricane forecasting, since 1940. Observations by volunteers were provided as early as 1914. The Island is also the site of a radionavigational beacon for Caribbean air traffic.

GEODETIC SURVEY MAP SHOWS CRUSTAL MOVEMENT

A new map of the United States showing vertical movements of the earth's crust indicates that the land in much of the country is slowly rising or falling and that very few really stable areas exist.

The first compilation of its kind for the United States, the map reveals probable annual rates of crustal movement over large regions.

The map is based on measurements made over the past 100 years by surveyors and geodesists of the National Geodetic Survey. Only the larger areas of land subsidence and uplift are shown on the map; much of it is based on interpolation between widely-spaced lines of elevation that have been measured by geodetic field parties.

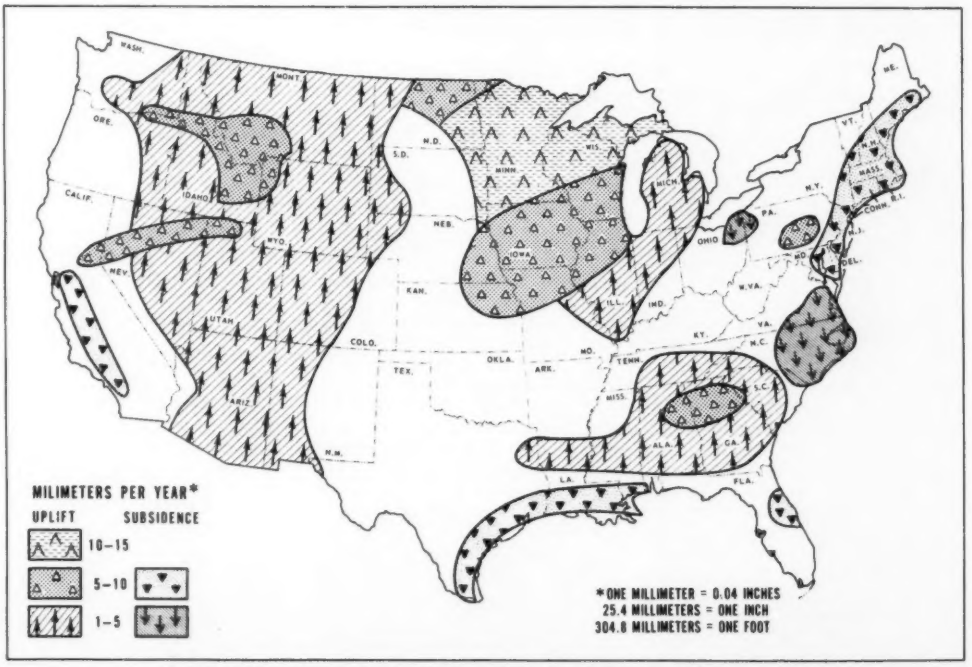
Some of these movements are minute, detectable only by painstaking and repeated measurements over a period of years. Others are large enough to be of concern in the design and maintenance of engineering structures, and in some areas land subsidence is sufficiently rapid to cause alarm. Samuel P. Hand, Chief of the National Geodetic Survey's Vertical Network Division, which developed the map, cited as one example of this the Houston-Galveston area in Texas which has subsided as much as five feet in 20 years. In the New Orleans area, a subsidence of more than one foot has been detected in a 25-year period.

These cities lie in a large area of subsidence which extends along the entire coastal plain of Texas and Louisiana. Hand said this rapid subsidence, and subsidence of the Central Valley in California, are largely the result of the removal of underground resources.

The NOAA geodesist pointed to Terminal Island at Long Beach, Calif., as an outstanding example of large-scale subsidence. Subsidence there reached more than 25 feet before it was checked by the injection of fresh water.

In such flat coastal areas, subsidence increases drainage problems and the danger of storm inundation. Among other areas so affected are the eastern shores of Delaware, Maryland, and Virginia and the vicinity of Atlantic City, N.J.

Whereas some subsidence is caused by man, widespread vertical movements are due to natural internal forces which are forcing the earth's crust up or down.



CRUSTAL MOVEMENT MAP SHOWING PROBABLE VERTICAL MOVEMENTS OF THE EARTH'S SURFACE

NMFS Builds Va. Reefs; One is World's Largest

An artificial reef system—to include the largest manmade reef in the world—is now being constructed off Virginia Beach, Va., using surplus LCM's acquired by NOAA from the U.S. Navy. The artificial reef program is under the management of NOAA's National Marine Fisheries Service.

Purpose of the reefs is to provide habitats for marine fish, with beneficiaries expected to be both sportfishermen and commercial fishermen.

Two reefs will be constructed. The first, about 15 miles offshore at Tower Reef, will consist of 39 craft and is expected to attract bottom and pelagic fish such as mackerel and bluefish. Its location should prove accessible to small boat fishermen.

The second reef, about 15 miles further out, will be the largest in the world, consisting of 127 craft and designed to attract big game fish such as dolphin, tuna, and various species of billfish.

The project came about through a cooperative effort involving Federal, State, and local agencies, made possible by the passage of the Dingell-Johnson Federal Aid in Fish Restoration Act of 1957. Involved were the State of Virginia, which gave permission and support for the venture; the Tidewater Artificial Reef Association of Virginia, which instigated and coordinated all planning for the planting of the reefs; the U.S. Navy, which assume the responsibility for cleaning and transporting the surplus vessels to their destinations after the craft had been transferred to NOAA; the Corps of Engineers, which issued permits for use of the underwater sites; and the Department of Commerce through NOAA, whose scientists provided data on reefs collected over a decade by NMFS.

The Virginia enterprise is the latest in a continuing series of artificial reef emplacements in almost all the coastal States and part of a broader program to both develop and conserve living fishery resources of the United States.

Surplus Navy LCM's being sunk to serve as artificial reefs.

CEDDA Moved to Data Service

NOAA's Center for Experiment Design and Data Analysis, directed by Dr. Joshua Holland, was transferred to the Environmental Data Service from the Environmental Research Laboratories on October 1, 1972. The transfer consolidates and strengthens NOAA's environmental data and information management system and related analytical functions.

CEDDA's mission is to assist project leaders in planning data collection, processing, and computational phases of major environmental field projects, to conduct quality and calibration tests during major meteorological and oceanographic experiments, and to participate in the scientific analysis of the data collected. Its current responsibilities are to complete the reduction and analysis of data collected in the Barbados Oceanographic and Meteorological Experiment conducted in 1969, and to service the International Field Year for the Great Lakes, now underway, as well as the Global Atmospheric Research Program's first international field project, the Atlantic Tropical Experiment scheduled for 1973.

FLARE Film Issued

"FLARE" (Florida Aquanaut Research Expedition), a 14-minute, sound, color, 16mm motion picture, has just been released and is now available on loan from NOAA's Motion Picture Service.

Filmed almost entirely underwater, the motion picture shows how teams of scientists, using a mobile habitat, remained underwater for about five days each to study the coral reef environment off the Florida coast near Miami.

Produced for NOAA's Manned Undersea Science and Technology program, the motion picture was produced by Elliot A. Macklow, Chief of the Motion Picture Service.

Large-Scale Marine Forecasts To Be Broadcast to Pacific

A new marine weather service for deep-water sailors in the Pacific will be inaugurated in February by the National Weather Service and the U.S. Coast Guard.

The service will consist of up to eight hours a day of forecasts and warnings transmitted by Morse telegraphy, voice, and radiofacsimile from the Coast Guard radio station at Point Reyes, California. When fully implemented, the transmissions will provide the first large-scale forecast and warning services especially designed for commercial shipping and fishing in the eastern North Pacific.

The transmissions will be made around the clock at frequent intervals timed to coincide with shipboard watch schedules in the North Pacific. Primary emphasis will be on predictions and warnings of storms, high winds, and waves. Areas of restricted visibility also will be emphasized.

A highlight of the new service will be transmission of radiofacsimile weather charts covering the eastern two-thirds of the North Pacific, and more-detailed weather charts of coastal and offshore areas of western North America. To receive these charts, radiofacsimile receivers renting for $100 to $250 a month will be needed.

Modification Rules In Effect

Rules for reporting weather modification activities to the Na-National Oceanic and Atmospheric Administration went into effect November 1, 1972.

The rules implement Public Law 92-205 of December 18, 1971, which requires all non-Federal weather modification activities in the United States and its territories to be reported to the Secretary of Commerce.

The reporting program is being carried out by NOAA on behalf of the Secretary, and is administered by the Office of Environmental Modification, headed by Donald F. Moore.

According to Mr. Moore, the rules are designed to obtain useful information, while placing the least possible burden on operators of weather modification projects. He emphasized that the reporting program involves neither regulation nor technical evaluation of weather modification operations, but rather will create a valuable source of data for those engaged or interested in such activities. The availability of information on past and current efforts at weather modification will help scientists and others concerned to avoid duplication of effort and territorial overlapping of operations.

Records of weather modification activities maintained by NOAA will be made publicly available to the fullest extent practicable.

Under the 1971 legislation, weather modification is any activity performed with the intention of producing artificial changes in the composition, behavior, or dynamics of the atmosphere. Presently excluded from the reporting requirement are use of lightning deflection or static discharge devices on aircraft, boats, or buildings, and use of small heaters, fans, fogging devices, and sprays to prevent frost damage to crops.

Schuck, Goodwin In Fisheries Posts

Howard A. Schuck has been named to manage the MARMAP (Marine Resources Monitoring, Assessment, and Prediction Program), launched by NMFS in mid-1972 to evaluate living marine resources in waters of the United States in mid-1972.

Mr. Schuck comes to NMFS from Anchorage, Alaska, where he served as manager of the Grumman Ecosystems Corporation. Before that he directed northern resources research at the University of Alberta, Edmonton, Canada, where he was responsible for evaluation of alternative methods of development of the Canadian Arctic. From 1944 to 1952, Mr. Schuck served as a marine fisheries biologist with the Interior Department's Fish and Wildlife Service in Boston and Woods Hole, Massachusetts.

Kenneth R. Goodwin has been appointed chief of the plans and policy development staff of the National Marine Fisheries Service.

Mr. Goodwin comes to NMFS from the Federal Communications Commission, where he served as a planning officer, and established the FCC's first office for long-range planning. Prior to joining the FCC early in 1970, he served for two years with the Bureau of the Budget as budget examiner for all Department of Commerce science and technology agencies.

Born in Hedley, Tex., Mr. Goodwin holds a bachelor of science degree from Yale.

Quake Resistance Of VA Hospitals To Be Measured

The Veterans Administration has contracted with NOAA to install instruments which will record strong-motions from earthquakes in some 65 VA hospitals across the United States.

Scientists and technicians from the San Francisco-based Seismological Field Survey (part of ERL's Earth Sciences Laboratories) are installing strong-motion accelerographs at VA hospitals in areas of significant seismic risk.

The instruments are designed to respond to the strong motions close to the epicenter of a major earthquake and provide a record of how buildings perform under earthquake conditions. This data will be used in connection with revisions to the building standards for VA facilities for earthquake-prone areas.

In addition to instrument installation, NOAA personnel will measure the vibrational characteristics of the hospitals and determine the response of selected structures to man-induced vibrations. In this kind of testing, a man shakes the structure by moving his body in time to the building's natural period. From the building's response to this very slight induced motion, structural engineers and engineering seismologists can evaluate the design characteristics of the building and estimate how the building will perform in a future earthquake.

Under the present VA contract with NOAA, selected hospitals in the following 30 states will receive strong-motion instrumentation: Alabama, Arizona, California, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Maine, Massachusetts, Missouri, Montana, Nebraska, Nevada, New Hampshire, New York, North Carolina, Ohio, Oklahoma, Oregon Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia.

Correction

The October NOAA Magazine story, "Disarming the Thunderstorm," stated, "According to Alan R. Taylor of the Northern Forest Fire Laboratory at Missoula, Montana, if lightning could be totally suppressed there would be 70 percent less western forest fires. However, some researchers contend that lightning and the fires it causes are necessary to maintain an ecological balance."

Mr. Taylor said only that lightning causes 70 percent of all forest fires in the western United States, and counts himself with those who believe that lightning-caused fires are necessary to the ecological balance of the forest complex.

U.S., France Begin Joint Project To Explore Mid-Atlantic Ridge

Deep diving research submersibles from France and the United States will plumb the depths of the mid-Atlantic Ocean for the first time in a three-year international scientific program.

The program, called FAMOUS (French-American Mid-Ocean Undersea Study), will make a detailed study of the Mid-Atlantic Ridge in an area some 200 miles south of the Azores. The submerged ridge is a major feature of the earth's surface but has not yet been studied at close range. First-hand study of the ridge is expected to furnish direct knowledge of how the earth's continents and oceans were formed, information that bears directly on the formation of metallic ore deposits and oil accumulation.

The Mid-Atlantic Ridge is a giant undersea mountain range that extends from the Arctic Ocean the entire length of the North and South Atlantic, and continues around Africa into the Indian Ocean. It is at an average depth of 7,200 feet, with a maximum depth of about 12,000 feet.

Until now, man's knowledge of the ocean floor has been obtained from indirect measurements from surface ships and deep-sea coring and dredging. By using submersibles, scientists will obtain samples direct from the rift valley in the center of the Atlantic ridge.

The submersibles will also emplace instruments on the ocean floor to provide a continuous supply of precise data on the dynamics of seafloor spreading.

FAMOUS is one of several scientific programs being undertaken as a result of a bilateral agreement between France and the United States. United States coordination in the field of oceanography is the responsibility of NOAA. Scientific coordination of FAMOUS is being handled by Woods Hole Oceanographic Institution, with financial support from the National Science Foundation, the Office of Naval Research, and NOAA.

The scientific program follows a plan recommended by an international group of scientists convened by the National Academy of Sciences at Princeton in January 1972 under the sponsorship of the United States Office of the International Decade of Ocean Exploration. Focus of the study is exploration of the mid-ocean rift system, which comprises a network of cracks in the seafloor up to 10 miles wide and two miles deep, virtually girdling the globe. A major objective of the research is to obtain evidence of volcanic-like activity apparently causing seafloor spreading and the gradual drifting of North America and Europe away from each other.

Co-scientific leaders for U.S. participation in the mid-Atlantic study are Dr. George Keller, Director of the Marine Geology and Geophysics Laboratory at NOAA's Atlantic Oceanographic and Meteorological Laboratories, Miami, and Dr. James Heirtzler, Chairman of the Department of Geology and Geophysics at the Woods Hole Oceanographic Institution.

Following two years of site surveys and training, a fleet will assemble at the site selected, in the summer of 1974. The French bathyscaphe ARCHIMEDE and French submersible SP-3000, the American submersible ALVIN, and four surface ships will carry out the most extensive deep ocean manned submersible study ever undertaken. Some 40 dives will be made at that time, with special missions for each submersible. The submersibles will do detailed mapping of the area, collect special bottom samples, and place instruments on the seafloor.

Each of the deep-diving research vehicles will have special assignments to make best use of their differing capabilities. The SP-3000, which has a high degree of maneuverability, will be used for rapid visual reconnaissance and for studies within the rift valley of the midocean ridge. ARCHIMEDE, a bathyscaphe designed for maximum depths and heavy payloads but in relatively gentle terrain, will explore the fracture zones of the seafloor. The highly maneuverable ALVIN, owned by the Office of Naval Research and operated by WHOI, will explore both terrains as well as the rift valley wall.

Ludwig Appointed To New NESS Post

Dr. George H. Ludwig, Associate Director for Data Operations of the National Aeronautics and Space Administration's Goddard Space Flight Center since 1971, has been named Director of System Integration at the National Environmental Satellite Service.

A native Iowan, Dr. Ludwig served in the U.S. Air Force from 1946 to 1952, becoming a pilot and attaining the rank of captain. He then attended the University of Iowa, earning his bachelor's and master's degrees in physics and his doctorate in electrical engineering. While earning his graduate degrees, he established at the University one of the first spacecraft instrumentation laboratories and developed the cosmic ray and radiation belt instruments for the successful Explorer 1, 3, 4, and 7 spacecraft. As co-experimenter for most of those investigations, he participated in the discovery and early delineation of the Van Allen radiation belts.

In 1960, Dr. Ludwig joined NASA's Goddard Space Flight Center as head of the Instrumentation Section of the Space Science and Applications Directorate.

Two-State Sea Grant Program Formed

At the ceremony launching the two-state program, from left, Dr. Athelstan Spilhaus; NOAA Deputy Administrator Howard Pollock; Harry Dent, Special Counsel to President Nixon; and Governor William Waller of Mississippi.

The states of Alabama and Mississippi have established the first two-state Sea Grant program. Ten research institutions will be involved in this regional approach to the development of the Nation's marine resources.

Participating institutions are the Universities Marine Center, a consortium of the Gulf Coast Research Laboratory, Mississippi State University, University of Mississippi and University of Southern Mississippi; and a consortium of Auburn University, Tuskegee Institute, University of Alabama, Birmingham, University of Alabama, Huntsville, University of Alabama, Tuscaloosa, and University of South Alabama.

all in the family

PERSONNEL NOTES

Dr. Arthur W. Green, Jr., formerly a senior physicist with Texas Instruments, Inc., in Dallas, Tex., has joined the Environmental Research Laboratories as Director of the Earth Sciences Laboratories' Geomagnetic Investigations Group.

Richard M. Morse, former Environmental Data Service Consultant for Marine Affairs, has been named Associate Director for Marine Affairs (EDS).

Thomas H. MacKenzie, Surface Observations Specialist at Kansas City, Mo., has been selected Official in Charge of the Grand Junction, Colo., Weather Service Office.

Kenneth B. Seal, a forecaster at Oklahoma City, has been selected to head the National Weather Service Office at Tulsa, Okla., Municipal Airport.

Commander Charles A. Burroughs is the new Executive Officer of the Seattle-based NOAA Ship SURVEYOR.

Mason A. Bennis, Principal Assistant at the Providence, R.I., Weather Service Office since 1964, has been appointed Meteorologist in Charge at Columbus, Ohio.

Lieutenant Commander John K. Callahan is the new Executive Officer of the NOAA ship PEIRCE.

Jerry H. Reed, who has been Senior Electronics Technician at Amarillo, Tex., since 1970, has entered on duty at the Weather Service Forecast Office in Indianapolis, Ind., to serve as the Area Electronics Supervisor for Indiana and Kentucky.

Dr. Hyman Orlin has been named Acting Chief Scientist of the National Ocean Survey.

Anthony E. Tancreto, who has been Chief of the Public Weather Branch in the National Weather Service Headquarters in Silver Spring, Md., since 1970, is the new Meteorologist in Charge at Boston, Mass.

Captain Gerald L. Short, who has been Director of the National Geodetic Survey Operations Center, Kansas City, Mo. for almost four years, is now Deputy Director of the Pacific Marine Center in Seattle, Wash.

Gerald A. Petersen has been named Chief of the Public Weather Branch in the Weather Analysis and Prediction Division at National Weather Service Headquarters. For the past two years he has been Program Manager of Field Station Automation in the Systems Plans and Design Division of the NWS Systems Development Office.

Bernard L. Spittler, formerly a Weather Service Specialist in Seattle, Wash., has been selected as Official in Charge of the Weather Service Office in Astoria, Oreg.

Commander Melvin J. Umbach has been placed in charge of the new Coastal Mapping Division at the Atlantic Marine Center.

Warren C. Caldwell, who has been Principal Assistant at the National Weather Service Forecast Office in Des Moines, Iowa, for the past 13 years, has been selected as Meteorologist in Charge of that office.

Jack J. Schnabel, a Weather Service Specialist at El Paso, Tex., since 1965, has been selected Official in Charge at Abilene, Tex.

Commander Darrell W. Crawford has been appointed Director of the National Geodetic Survey Operations Center in Kansas City, Mo.

Lieutenant Commander Jeffrey G. Carlen is the new Executive Officer of the NOAA Ship MT MITCHELL. He was previously the ship's Operations Officer.

Roland Guy Loffredo, a forecaster in Pittsburgh, Pa., since 1968, has been appointed Meteorologist in Charge of the Weather Service Office in Wilmington, Del.

Walter L. Newman, Weather Service Specialist at the Fort Smith, Ark., Weather Service Office, has been appointed Official in charge of that office.

Morton B. Peterson, Weather Service Specialist at the Weather Service Office in Grand Rapids, Mich., has been selected Official in Charge at Muskegon, Mich.

George J. Matuella, Meteorological Technician (Observational Specialist) at the Weather Service Meteorological Office in North Omaha, Nebr., has been selected to be Official in Charge at that office.

Lieutenant Commander Carl N. Davis is the new NOAA liaison officer at Fort Sill, Okla. He recently served as Executive Officer of the NOAA Ship PEIRCE.

Ms. Rosa Hill of the Personnel Relations Branch, Personnel Division, has been designated to serve as the Federal Women's Program Coordinator for NOAA.

A. L. Zimmerman has been selected to be the new Meteorologist in Charge at the Seattle, Wash., Weather Service Forecast Office. He was formerly the Hydrologist in Charge at the Salt Lake City River Forecast Center.

Terry A. Ritter is the new Meteorologist in Charge of the Norfolk, Va., Weather Service Office. He has been MIC at the Akron, Ohio, WSO for the past six years.

Charles M. Woffinden, former Chief of Operations for the National Weather Service Central Region, has been appointed to a newly created position as NWS representative to the Air Force's Air Weather Service and the Environmental Research Laboratories.

Barry B. Aronovitch has assumed responsibilities of Meteorologist in Charge of the Weather Service Office in Olympia, Wash., where he has been Fire-Weather Meteorologist since 1967.

Stephen J. Powell, staff attorney in NOAA's Office of General Counsel, is now staff legal advisor to the Director of the Northwest Administrative Service Office, Seattle.

Edwin J. Heath, who has served as a Weather Service Specialist at Columbus, Ohio, since 1962, has been named Meteorologist in Charge of the Akron, Ohio, Weather Service Office.

James B. Jones, who has been chief of the National Environmental Satellite Service's Planning and Coordination Group since 1968, has transferred to the National Weather Service as chief of the Meteorological Satellite Staff.

Bernard Hull, who has been serving as Chief, Operations Branch in the Personnel Division, has been reassigned to the new position of Chief, Planning and Evaluation Branch.

Roy C. Brown, formerly a Personnel Staffing Specialist with the Office of Personnel, Department of Commerce, has replaced Mr. Hull as Chief of the Personnel Operations Branch.

Raymond M. Lumpkin, formerly Chief of the National Weather Service Central Region Personnel Division, has transferred to the headquarters of the NOAA Headquarters Personnel Operations Unit.

Frederick P. Ostby, Jr., Procedures Development Program Leader in the Technical Procedures Branch of the Weather Analysis and Prediction Division at the NWS Headquarters, has been named to fill the new position of Deputy Director of the National Severe Storms Forecast Center and Chief of the Severe Storms Service Improvement Program in Kansas City.

Dr. William D. Bonner, formerly with the National Weather Service Techniques Development Laboratory, is chief of the new Data Assimilation Branch formed within the Development Division of the National Meteorological Center.

Frederick F. Ceely, Jr., has been named Chief of the National Ocean Survey's Electronics Computing Division. He was previously Assistant Chief of the Division and Chief of the Planning Branch.

Andrew J. Kennedy has been appointed Chief of the NOS Electronics Computing Division's Programming Branch.

James E. Skyrm has been selected to fill the position of Meteorologist in Charge of the National Weather Service Office at Waycross, Ga. He has served at Brownsville since 1971.

Ray H. Barnes has been selected as the Meteorologist in Charge of the National Weather Service Office in Mobile, Ala., where he has served as Principal Assistant since 1969.

Forecasts of Snow Probability Automated by NWS

The National Weather Service's Techniques Development Laboratory has developed an automated system that produces nationwide forecasts of conditional probability of frozen precipitation (snow or sleet) out to 48 hours. The new product, which became operational on November 1, should help forecasters anticipate whether or not expected precipitation will be in frozen form.

The automated forecasts are available for 152 stations in the conterminous United States and issued twice daily (0720 GMT and 1920 GMT) in the form of a new teletypewriter bulletin on Service C. The bulletin also contains probability of precipitation forecasts computed from an automated system developed earlier within the Techniques Development Laboratory. In the near future, a new chart containing forecasts of both weather elements will appear twice daily on national facsimile.

The new product was developed by Dr. Harry R. Glahn and Joseph Bocchieri, and implemented by Frank Lewis.

Gross Named Chief Of Ocean Services; Hirsch Heads MESA

Dr. M. Grant Gross, formerly Acting Director of the Marine Sciences Research Center and professor of oceanography at the State University of New York, Stony Brook, is now chief of the Oceanographic Services Division in the Office of Environmental Monitoring and Prediction.

He taught oceanography at the University of Washington and was associate curator of sedimentology at the Smithsonian Institution, before joining the SUNY Marine Sciences Research Center at Stony Brook in 1968.

Dr. Allan Hirsch has been appointed Director of the Marine Ecosystems Analysis Program in the Office of Marine Resources.

Since 1971, Dr. Hirsch has been with the Environmental Protection Agency, where he was Director, Division of Program Development. From 1966 through 1970, he was Assistant Commissioner of the Federal Water Quality Administration.

Fifteen Receive Commerce Medals

Top row, l to r: I. Y. Fitzgerald J. Austin Yeager, Joseph W. Greenough, Vernon F. Dvorak, Roger S. Rhodes, Herman C. Anderson, Arthur G. Alexiou
Bottom row, l to r: Dr. White, Olin R. Houston, Kikuro Miyakoda, Joanne Simpson, Clayton E. Jensen, Charles A. Whitten, Robert D. Wildman, Howard W. Pollock

Five Gold Medals and ten Silver Medals were presented to NOAA employees by Secretary of Commerce Peter G. Peterson in the October 30 honors awards program at the Commerce Department.

Recipients of the Gold Medal, the Department's highest honor, were:

Herbert P. Benner, radarmeteorologist in the Operations Division of the National Weather Service's Western Region Headquarters in Salt Lake City, Utah, for his outstanding services in the field of radar meteorology. He was honored for his unusual initiative in developing utilization of the Federal Aviation Administration's Air Route Traffic Control radars to complete national radar weather coverage. The expansion of this program has provided nearly complete coverage for the West, and has greatly improved weather services at a fraction of the cost of establishing independent weather radars.

Dr. Clayton E. Jensen, who leads NOAA's environmental monitoring activities, for his leadership in formulating plans for global environmental monitoring and for protection from natural disasters. He was cited for the extraordinary organizational ability and technical competence demonstrated "in leading the national efforts, on behalf of NOAA, in preparing for the United Nations Conference on the Human Environment," held at Stockholm in June 1972. Also during the past year, he led the preparation of a report for the Executive Office of the President on new technological opportunities for protecting life and property from natural disasters.

Dr. Kikuro Miyakoda, group leader at the Environmental Research Laboratories' Geophysical Fluid Dynamics Laboratory in Princeton, N.J., for developing a computer model potentially capable of accurately forecasting atmospheric conditions a week in advance. In addition, Dr. Miyakoda has mathematically defined the atmosphere's intrinsic predictability limits. These and other innovative improvements in atmospheric modeling distinguish him as a leader in his field.

Dr. Joanne Simpson, director of ERL's Florida-based Experimental Meteorology Laboratory for pioneering research in tropical weather modification. Under her direction, EML participated in a joint Federal-state program to attempt to mitigate the 1971 Florida drought. This effort contributed an estimated five to ten percent of the actual April-May rainfall in southern Florida. By pioneering in the development of a forecasting and research cumulus cloud computer model, she has moved her laboratory to the frontier of weather modification research.

Dr. Charles A. Whitten, former chief geodesist of the National Ocean Survey, for his worldwide leadership in geodesy, especially for advancing new concepts to improve man's understanding of crustal motion of the earth. His citation stated, "His methods for analyzing precise geodetic measurements are effectively contributing to the investigation of large-scale seismic mechanisms and may someday lead to the prediction of earthquakes."

Silver Medals, the Department's second highest honor, presented to:

Arthur G. Alexiou, of the Office of Sea Grant, for his role in establishing and maintaining the Institutional Support and Sea Grant College Program in the National Sea Grant Program.

Herman C. Anderson, chief of the Chart Information Branch in the NOS Marine Chart Division, for his role in the development of a cooperative charting program which enlisted the aid of the U.S. Power Squadrons and the U.S. Coast Guard Auxiliary in the maintenance of up-to-date nautical charts.

Vernon F. Dvorak, a meteorologist in the Analysis Branch of the National Environmental Satellite Service's Data Processing and Analysis Division, for an outstanding contribution to increased usefulness of satellite data in the analysis of tropical storms.

Isaiah Y. Fitzgerald, chief of the Coastal Surveys Section of the NOS Coastal Mapping Division, for his role in the development of remote sensing techniques for gathering field data for surveys of coastal waters.

Joseph W. Greenough, a biometrician with the National Marine Fisheries Service Auke Bay, Alaska, laboratory, for valor above and beyond the call of duty when he volunteered for and participated in a search-and-rescue mission following the crash of a commercial airline plane in Alaskan mountains in September 1971.

Olin R. Houston, deputy chief of the Basic Weather Forecast Branch at the National Meteorological Center in Suitland, Md., for his exceptional accomplishment in the improvement of computer-produced weather forecast charts.

Roger Rhodes, assistant director of ERL's Wave Propagation Laboratory in Boulder, Colo., for outstanding administrative leadership and his valuable contribution to the future of atmospheric remote-sensing techniques.

Arnold L. Sugg, deputy director of the NWS' National Hurricane Center in Miami, Fla., for his exceptional services in developing and administering an important program of hurricane-warning services.

Robert D. Wildman, of the Office of Sea Grant, for his role in establishing special marine science projects in the National Sea Grant Program.

Commander J. Austin Yeager, chief of the Satellite and Marine Applications Division of the NOS, for his role in the world satellite triangulation program, a four-year effort involving 32 nations which resulted in the most accurate measurement made for determining the size and shape of the earth.

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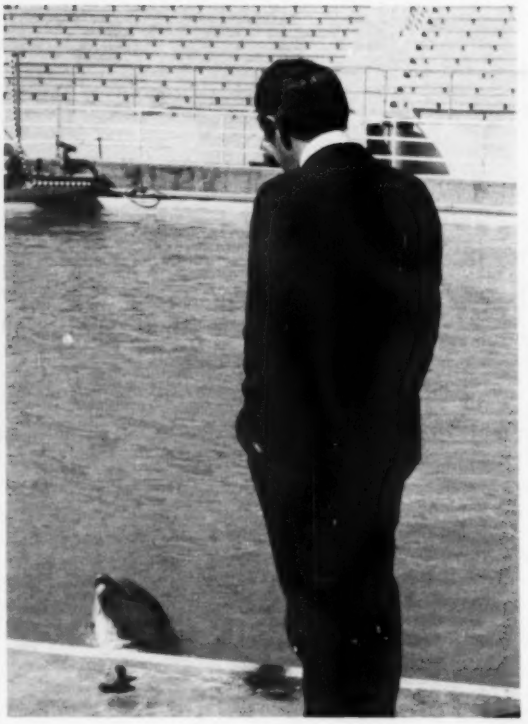

Photographs by Frank Oxley

Flipper and friend at Marineland of the Pacific (see page 54).